SAE journal

NOVEMBER 1955

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New **PERFECT CIRCLE** type **"98"** chrome oil ring!

Of the 6,003,603 U.S. passenger cars produced from Jan. 1 through Oct. 1 more than half* were equipped with the new Perfect Circle type "98" chrome oil ring!

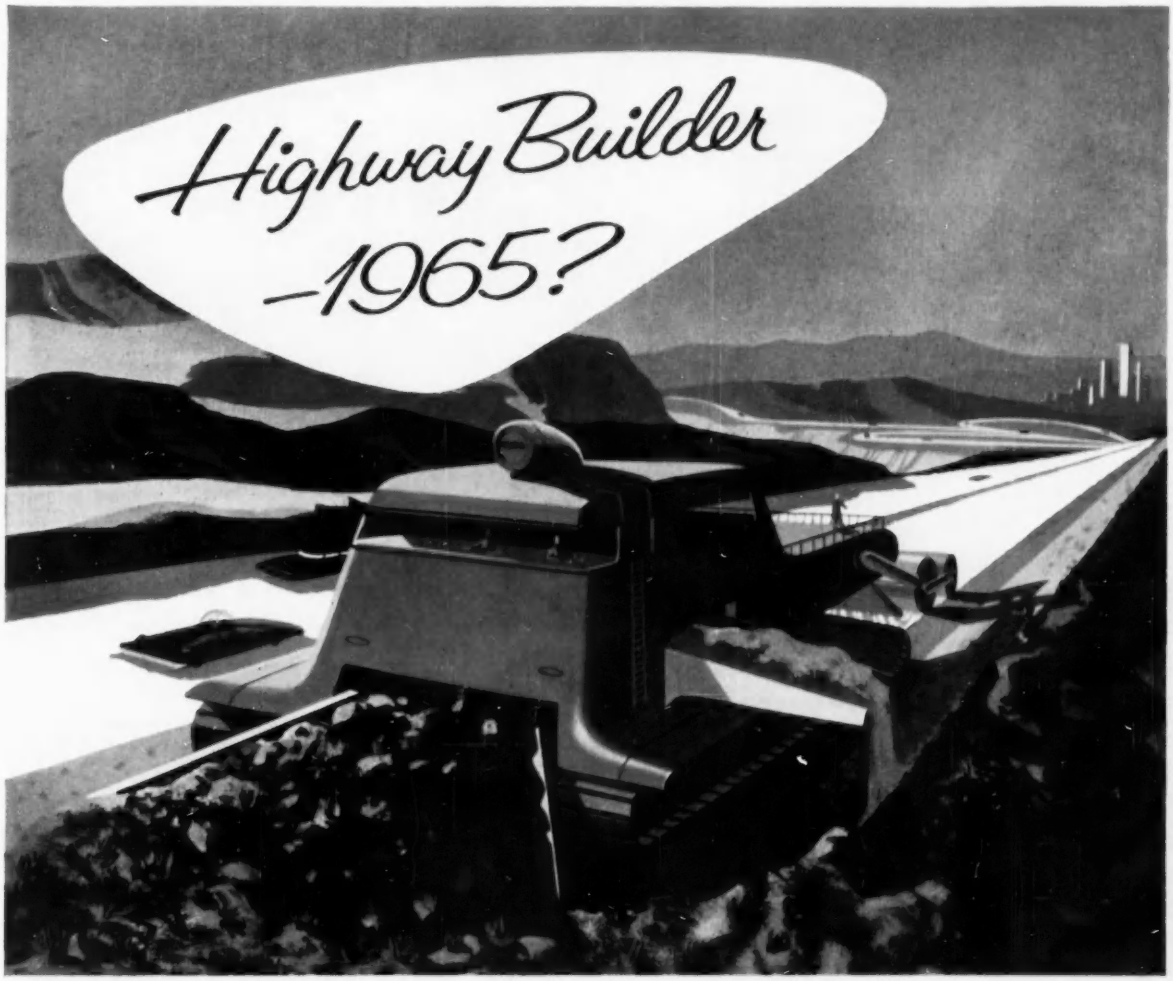
Better than any other oil ring for new high-compression, high-vacuum overhead valve engines!

- Uniform pressure on entire circumference!
- Multiple tiny springs exert both side and radial pressure!
- Provides maximum oil drainage!
- Constant flexing retards carbon accumulation!

*51.5% were new Perfect Circle Type "98" Chrome Oil Rings. 48.5% were all other oil ring types combined, including other Perfect Circle oil ring types.

Perfect Circle Corporation, Hagerstown, Indiana;
The Perfect Circle Co., Ltd., Toronto, Ontario.

NEW DEPARTURES OF TOMORROW



TOMORROW: A ribbon of paving unreels as this road-builder of the future turns open country into superhighway.

TODAY: New Departure ball bearings are used in power shovels, trucks and similar heavy-duty equipment, because they require no special attention and virtually no maintenance. Frequently they outlast the machine itself.

What a simple matter road building would be if it were reduced to a single machine that levels, grades and paves . . . all in continuous operations. Such future prospects are often made practical through New Departure ball bearings. With New Departures, moving parts are held in close alignment while handling loads from any angle. Delays for adjustment and maintenance are eliminated. That's because these ball bearings are designed for high capacity and manufactured to close precision tolerances . . . by the company that has originated many of the greatest advances in ball bearings. So if you are designing or improving a product for efficiency and endurance, call New Departure for *your* ball bearings.

NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL, CONNECTICUT

NEW DEPARTURE
BALL BEARINGS

NOTHING ROLLS LIKE A BALL

the new vinyl-to-metal laminating process?

Larger families... more rough 'n tumble in the back seat.
Smaller taxicabs... more knocks and scrapes from suitcases and boxes.
Increased stationwagon registrations ... more scuffs and bruises from bigger, shifting packages.

These three trends emphasize the importance of new protective materials like Marvibonded metals. Marvibond* is the new laminating process that permanently bonds vinyl sheeting to practically any kind of metal.

Seat backs and frames

Marvibond vinyl-to-metal laminates...

- **can't rust, rot or corrode!**
- **are attractive, pleasant to touch!**
- **can't chip, crack, or craze!**
- **are scuff- and stain-resistant!**
- **are clean, comfortable, easy to maintain!**

Prefinished sheet metal! Marvibonded metals are laminated before forming. Neither finish nor bond is affected by bending, crimping, drilling, embossing, punching, or drawing.

Practically any surface effect! High finish or matte finishes, leather-like grains, marble patterns, prints, weaves, and sculptured appearances can be achieved economically.

Marvibonded laminates can be used where sheet metal is used... dashboards, window trim, door panels, truck cabs, and other automotive interior components. So, why not consider what the Marvibond process offers in beauty, protection, serviceability, extra sales impetus and real production economies? For technical data and samples, and the names of licensed Marvibond laminators in your area, please write—

*Patent applied for

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Division of United States Rubber Company
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Precision Dyna-Seal

speedy, low cost solution to leak-proof sealing

PRECISION DYNA-SEALS quickly solved the sealing problem for The Aircraftsmen Co., of Gardena, California, in the assembly of fabricated components for incendiary bombs. Dyna-Seals, under bolt heads, provided the desired combination of positive leak-proof performance, ease of installation and low initial cost.

PRECISION Dyna-Seals offer the simple solution to many face-to-face sealing problems for a wide range of industrial products too. This *one piece* item, made of a synthetic rubber sealing member bonded to a steel washer, cuts assembly costs by eliminating the need for special grooves and machining. It gives a flexing lockwasher action that assures a positive seal against constant or pulsating pressures up to 10,000 psi. There's no overtorquing of bolts with Dyna-Seal.

Use PRECISION Dyna-Seals on any flat surface under bolt or rivet heads, flanges and special fittings as seals against petroleum products, water, air, gases, coolants and other fluids. Let PRECISION demonstrate the advantages of putting Dyna-Seals in your products. Write or call for the Free Dyna-Seal catalog of factual information.

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FREE—Write for your personal copy of our handbook on Dyna-Seals

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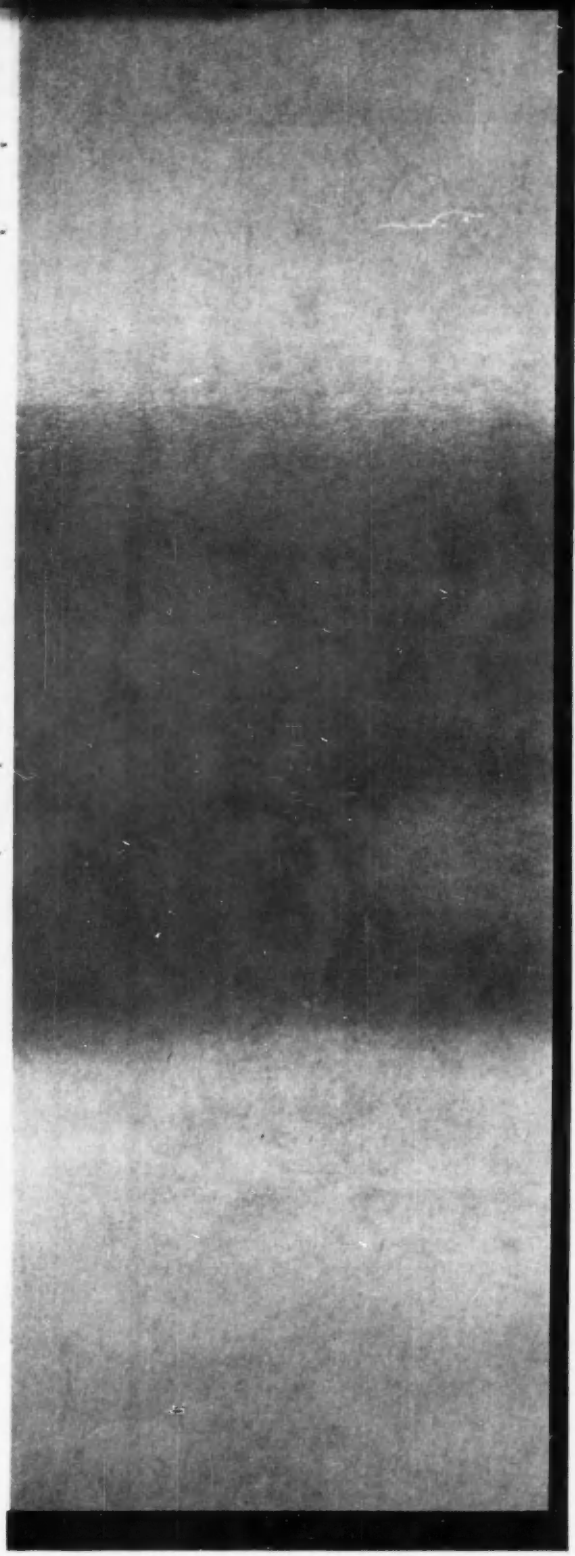

Lycoming harnesses the hot breath of a new era

Now, in the lungs of Lycoming's advanced gas turbines developed for the Military—the turbine principle finds new usefulness, this time for helicopters. Employing broad knowledge and bold thinking in aerodynamics, thermodynamics, and metallurgy, scientists of Avco's Lycoming Division have achieved in the T 53 turbine important design advantages: dramatic compactness (never before has 800 H. P. been housed in so little space), versatility in installation and operating characteristics, high efficiency, ruggedness, long life, and low production cost. The T 53, developed in close cooperation with the U. S. Air Force and U. S. Army Transportation Corps for helicopter use, also broadens the benefits of turbine power to fixed wing aircraft and many other mobile and stationary applications. Through advanced turbines—as well as improved reciprocating engines, better components, finer precision parts —Lycoming translates research into practical realities for defense, for peace.

The turbine era is here. A broad variety of future non-military applications of gas turbines awaits the ingenuity of industry. If your plans are in any way linked to power—turbine or reciprocating—now is the time to look to Lycoming! Write on your letterhead to Lycoming, Stratford, Conn. Ask for T-53 booklet.

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and can take
any shape

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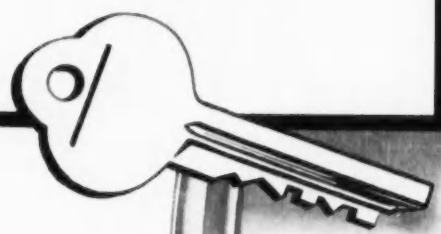
This could be the key to bigger pay loads



Exclusive Goodyear Bond-a-Coat finish resists corrosion and discoloration, keeps its luster indefinitely.

RIMS may be a relatively small item in your budget, yet choosing the right ones can mean big over-all savings.

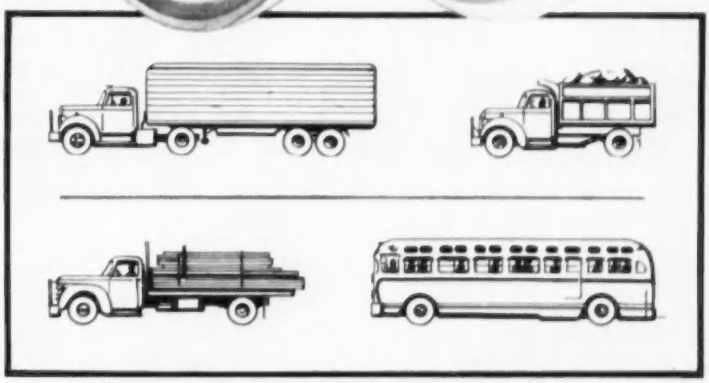
For example, Goodyear Wide Base Rims, in nearly all sizes, weigh less than standard-size wide base rims. *When you specify these lighter rims, you can haul as much as a hundred pounds' extra pay load on a tractor-trailer unit.*

The Mileage Adds Up, Too

What's more, Goodyear Wide Base Rims roll up extra tire mileage – up to 30% extra, according to service records of big fleet operators. The reason is that these superior rims help to reduce sidewall flexing–resulting in less tire heat, fewer tire failures and road delays.

Lower Cost

And here's the topper: even their initial cost is lower. Your Goodyear Rim Supplier can give you complete details. Or write Goodyear, Metal Products Division, Akron 16, Ohio.



GOODYEAR

WIDE BASE RIMS

MORE TONS ARE CARRIED ON GOODYEAR RIMS THAN ON ANY OTHER KIND

HOW R/M ENGINEERING SETS

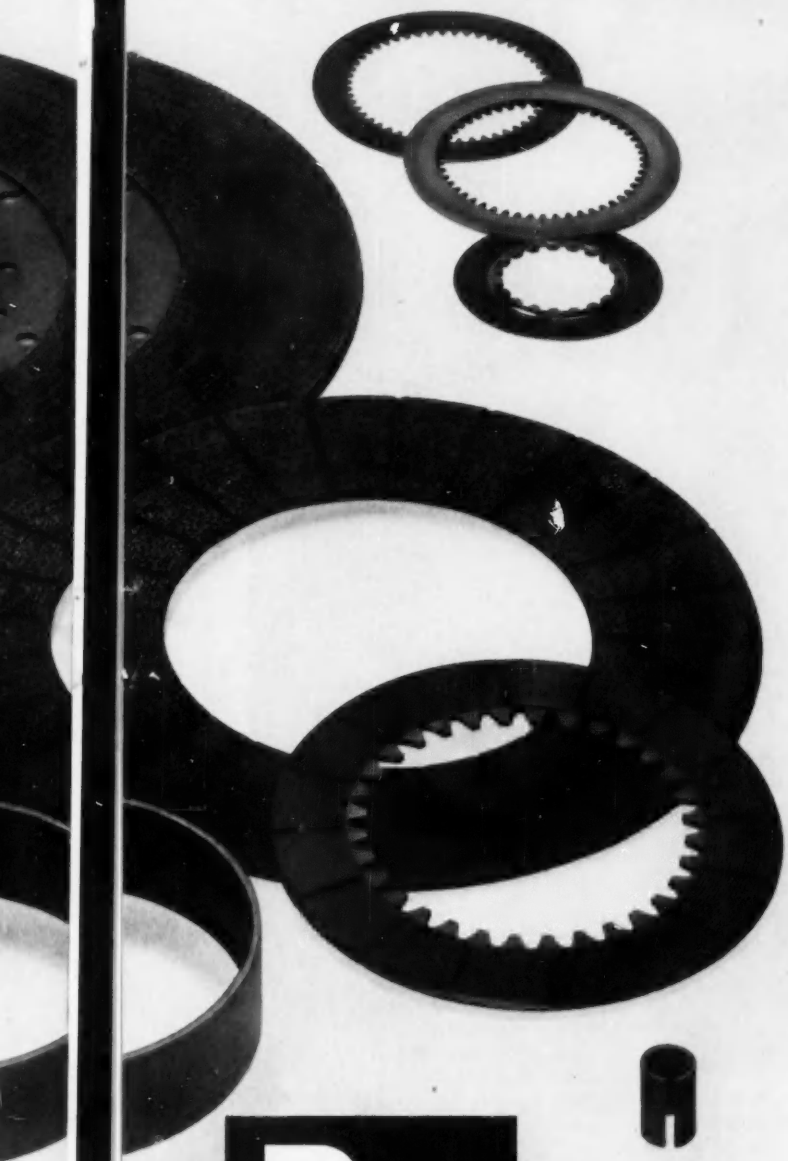
R/M
FIRST IN FRICTION

Pictured above are a few of the many friction material parts made and bonded by Raybestos-Manhattan—brake linings, clutch facings, and automatic transmission bands and plates. The latter present a particularly good example of the need for bonding. Only .015" thick, with grooves .007" deep, they do not permit riveting.

THE RECORD OF "FIRSTS" IN FRICTION MATERIAL DEVELOPMENT SHOWS WHY R/M IS FIRST IN FRICTION

FIRST Woven Brake Lining • FIRST Asbestos Brake Lining • FIRST Ground Wearing Surface • FIRST Zinc Alloy Wire Brake Lining • FIRST Pre-Treated Yarns • FIRST Extruded Pulp Brake Lining • FIRST Flexible Pulp Brake Lining in Rolls • FIRST Dry Process Brake Lining • FIRST Semi-Metallic Brake Lining • FIRST Bonded-to-Metal Brake Lining • FIRST Woven Clutch Facings • FIRST Molded Asbestos Clutch Facings for Clutches Operating in Oil FIRST Endless Woven Clutch Facings • FIRST Pre-Treated Clutch Facings • FIRST Bonded-to-Metal Clutch Facings

THE PACE IN FRICTION MATERIAL DEVELOPMENT



BONDING

The bonding of friction materials to other mating members is an art. Raybestos-Manhattan, for fifty years the world's largest maker of friction materials, has spent a longer time than any other company acquiring proficiency in it. Each successive job we've tackled has added to our knowledge of friction materials behavior, metals handling, heating cycles, adhesive selection, and the like. Consequently, we offer you bonding know-how and experience second to none.

Trouble-shooting field trips—hundreds and hundreds of them—have familiarized R/M engineers with countless bonding problems. So the chances are that if one is confronting you, R/M has already solved it. Example: a manufacturer could not bond R/M-furnished, semi-metallic strips to his automatic transmission bands without developing blisters. R/M engineers found that gas generated by the adhesive was causing the trouble. Our engineers recognized the condition as one they had encountered in bonding other materials. By installing a breather—a momentary release of pressure in the bonding cycle—they eliminated the problem.

R/M can bond to almost any type material. Steel is the mating member most frequently used. But R/M can also bond to aluminum, phosphor bronze, and fibrous materials.

R/M is at home in both the asbestos and metal fields, working with all friction materials. You are assured of unbiased advice on these materials when you consult an R/M engineer. Our contributions to today's automatic transmissions prove the point. Every model of full or semi-automatic transmission for passenger cars (many trucks, too) is equipped with one or more R/M friction products—sintered metal, semi-metallic, woven, molded, or cork-cellulose.

If you are working with friction materials, we suggest that you call in an R/M representative. It will pay you to take full advantage of our experience and the facilities of our seven plants, with their research and testing laboratories.

Write for your free copy of R/M Bulletin No. 500. Its 44 pages are loaded with practical design and engineering data on all of R/M's friction materials.

RM
FIRST IN FRICTION

THE TRADE-MARK THAT SPELLS PROGRESS IN FRICTION MATERIAL DEVELOPMENT

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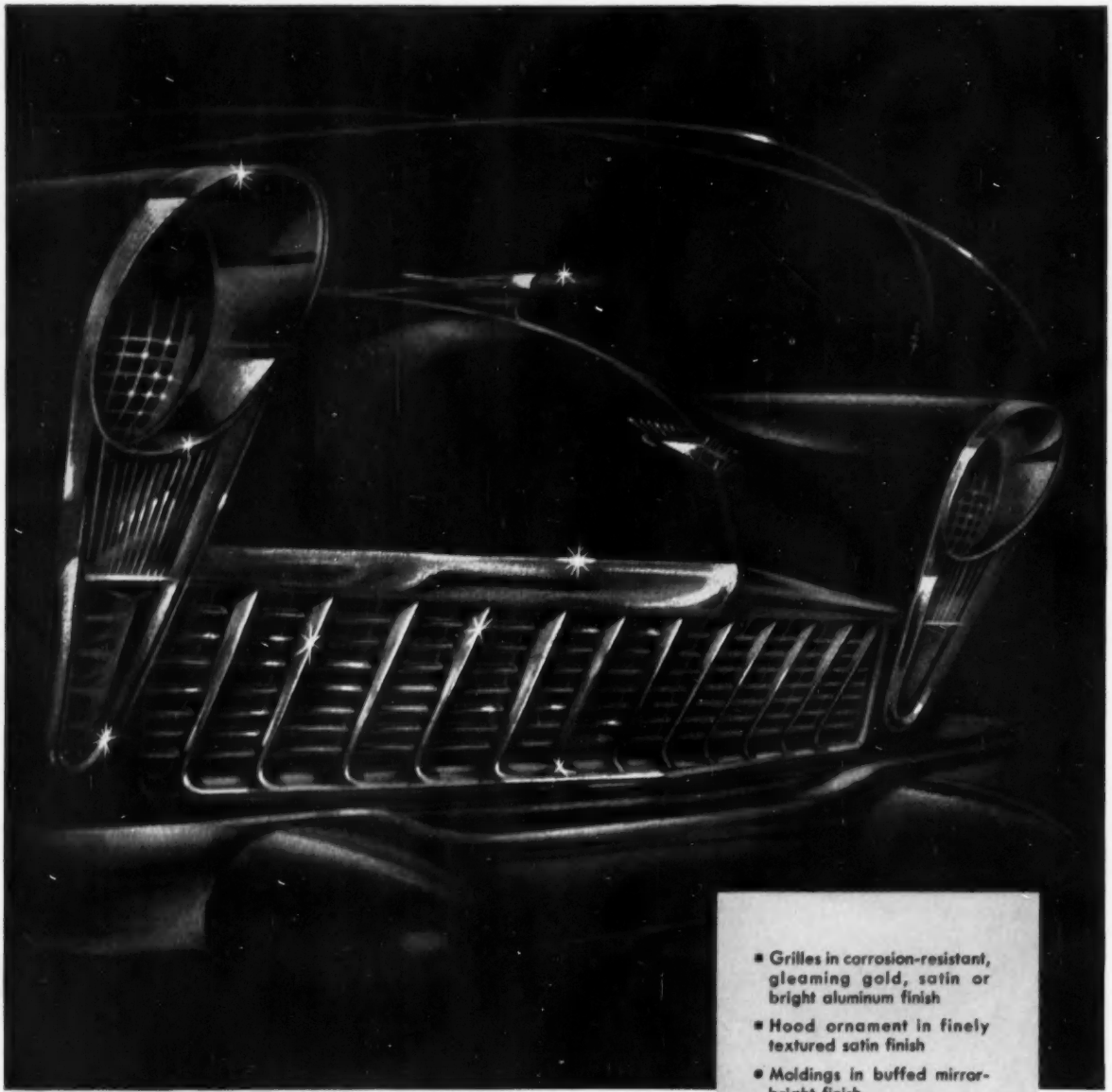

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Alcoa does not make grille components. We *do* offer you unequaled technical guidance in fabricating and finishing aluminum. To make use of this service, contact the nearest Alcoa sales office. For useful design data, write for our new, free 48-page brochure, *Finishes for Alcoa Aluminum*. Address: Aluminum Company of America, 1844-L Alcoa Building, Pittsburgh 19, Pa.

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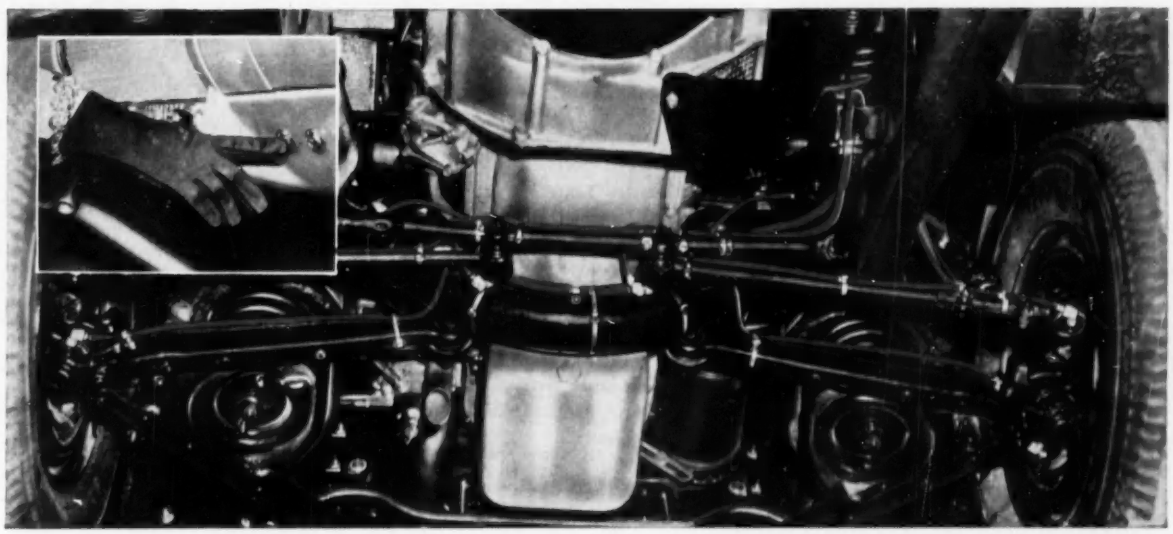
AUTOMOTIVE ENGINEERING NEWS

PROPERTY AND APPLICATION DATA ON THESE VERSATILE ENGINEERING MATERIALS: "ZYTEL," "ALATHON," "TEFLON," "LUCITE."



A MERE PRESS OF THE DASHBOARD BUTTON activates a master lubrication cylinder. This forces a premeasured amount of specially compounded lubricating grease through tubing of "Zytel" nylon resin to each bearing. Available on both Lincoln and Mercury automobiles, this self-contained lubrication system assures proper lubrication of all points equipped with grease fittings. (Tubing of "Zytel" nylon resin is fabricated by The Polymer Corp. of Reading, Pa., under the trade-mark "Nylaflow.")

Rugged, flexible tubing of ZYTEL® nylon resin used throughout new power lubrication system

Newest addition to power accessories for passenger cars is the Multi-Luber, a development of the Lincoln Engineering Co., of St. Louis, Missouri.

The system consists of a control button on the instrument panel and an injector pump located in the engine compartment. Tough, flexible lines of "Zytel" nylon resin extend from the pump to 12 key points on chassis, suspension and steering systems.

Lubrication in seconds . . . A touch of the control button admits vacuum from the intake manifold to the injector pump starting the lubrication cycle. In a few seconds lubrication is completed from a 7-oz. disposable can of lubricant supplying the system. The Multi-Luber provides 225 chassis lubrications before it is necessary to replace the can.

High burst strength required . . . The network of feed lines must necessarily meet rigid specifications. They are ⅛" O.D. x 0.080" I.D. and can withstand a burst pressure of approximately 2,500 p.s.i. *(Under normal conditions injection pressure is about 2,000 p.s.i. at the bearing ports.)*

Rigid road tests proved how well "Zytel" withstands heat, cold and flexing—how impervious it is to oil, grease, and gasoline. Lincoln Engineering found that the lightness in weight of "Zytel" nylon resin was another important advantage that determined its selection for this application.

NEED MORE INFORMATION?

The wide range of properties available with the DuPont engineering materials – "Zytel," "Lucite," "Teflon" and "Alathon" – are helping solve many industrial design problems. Clip and mail the coupon for complete property and application data.

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Please send me more information on the Du Pont engineering materials checked: ☐ "Zytel"* nylon resin; ☐ "Lucite"* acrylic resin; ☐ "Teflon"* tetrafluoroethylene resin; ☐ "Alathon"* polyethylene resin. I am interested in evaluating these materials

for_____

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POSITION_____

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For the Sake of Argument

Zest from the Zestful: Clarity from All . . .

By Norman G. Shidle

Swinburne once said of Walt Whitman:

"What he says is well said when he speaks of himself and because he cannot choose but speak. . . . What he says is not well said when he speaks but as though he ought."

That might be said of everyone whose job involves even an occasional writing chore. Writing comes easiest when we have a story we are burning to tell. Something of the heat from an inner flame almost surely warms our words—be they written or spoken.

But in business, duty often bids us write whether we want to or not. Letters must be answered; memoranda have to be written; instructions issued; programs detailed.

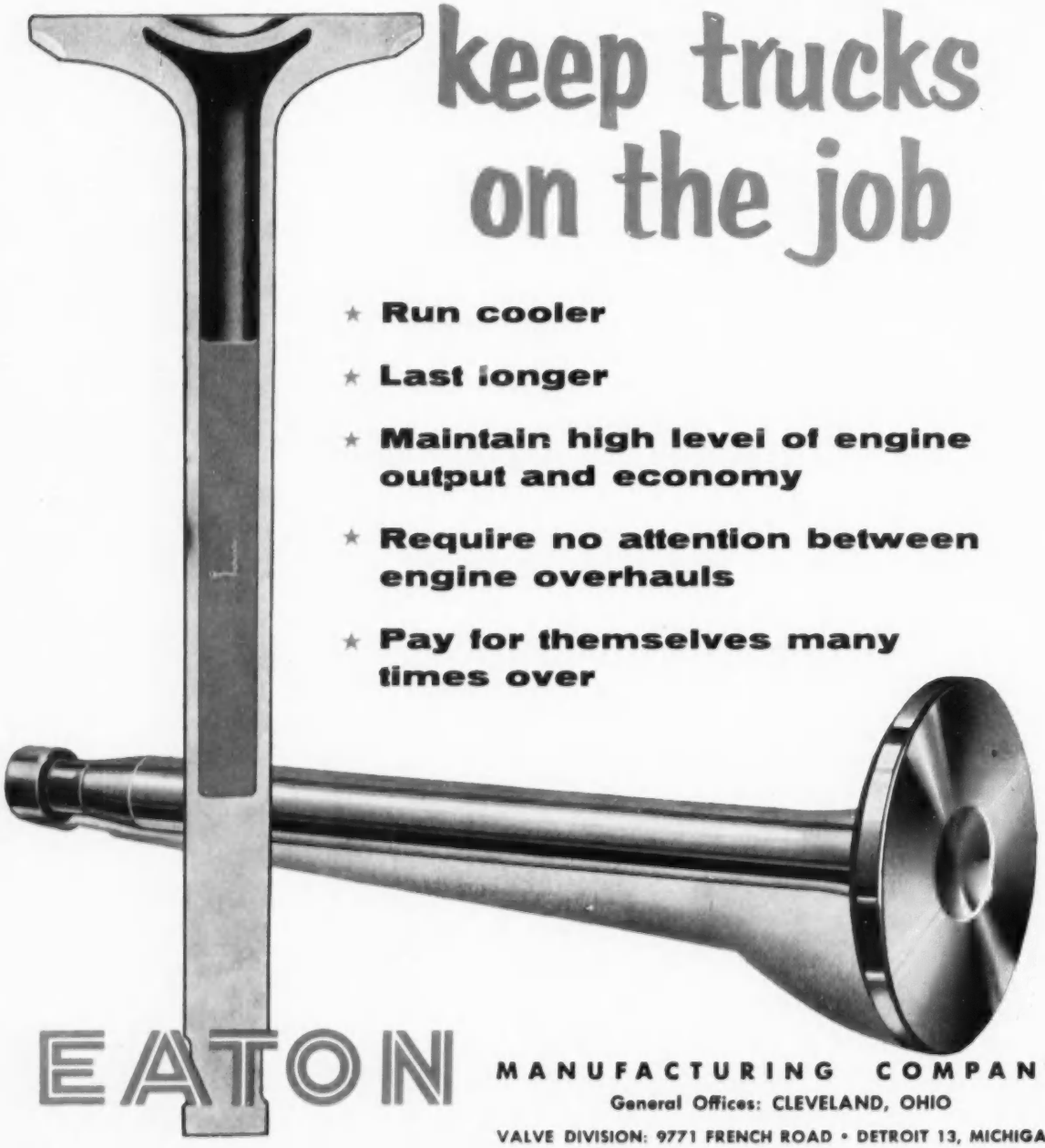
Daily we must communicate facts and ideas when nothing inside us cries: "Let me out!" We must communicate about phases of our work for which we have the least relish. We can't confine our writing to the parts of our job which inspire us.

That's why the average business writer had best rely on becoming the writer-equivalent of a good draftsman. He may not produce the ultimate beauties of the creative artist; but neither will he spawn any gnarled or repulsive ugliness. He will bless his fellow men with letters and memos and instructions and summaries which are clear, if not zestful; lithe, if not racy.

Even when he is excited about the facts or ideas he is communicating, his good "draftsmanship" will make his writing better. It will be a sound framework for the creative piece his zest will produce.

More executives every year are recognizing clear writing to be the result of clear thinking. So, they are looking at what a man writes as a clue to how he thinks. . . . And they are saying: "Hail to the man who can communicate. We can find wider uses for the kind of thinking processes that result in good communication."

Eaton SODIUM COOLED VALVES keep trucks on the job



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1905 S·A·E GOLDEN ANNIVERSARY 1955

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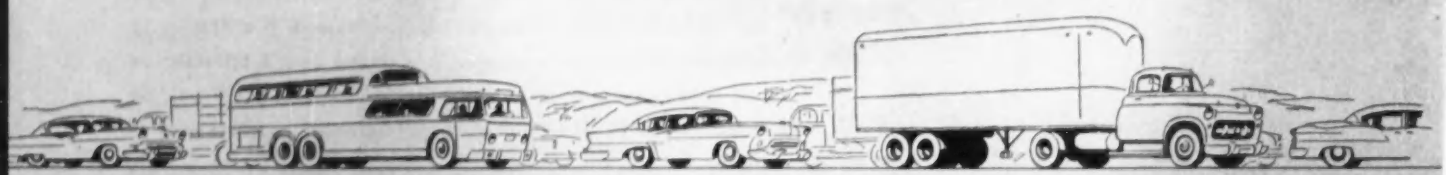
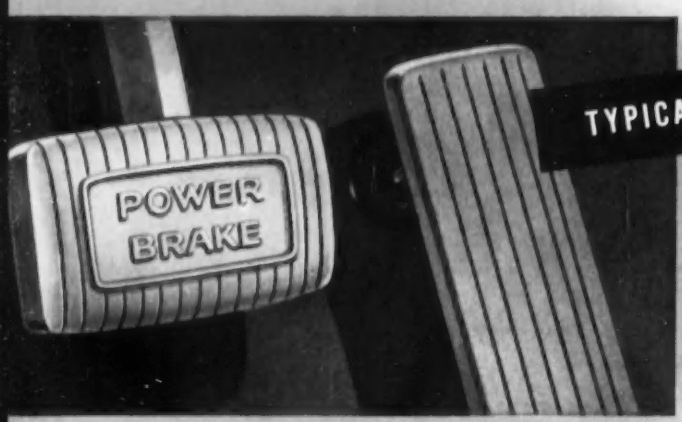
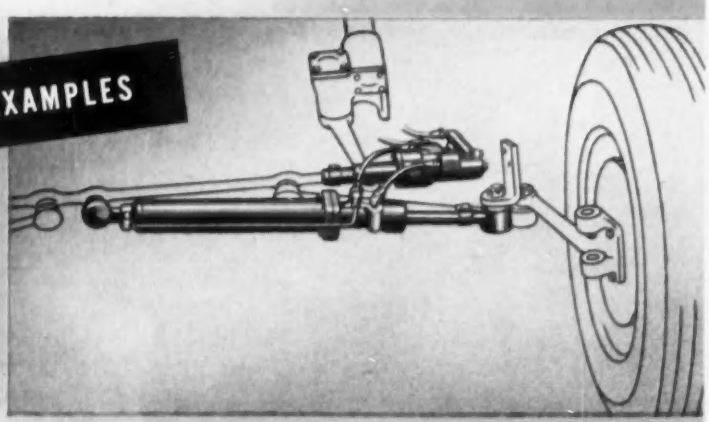




TYPICAL EXAMPLES



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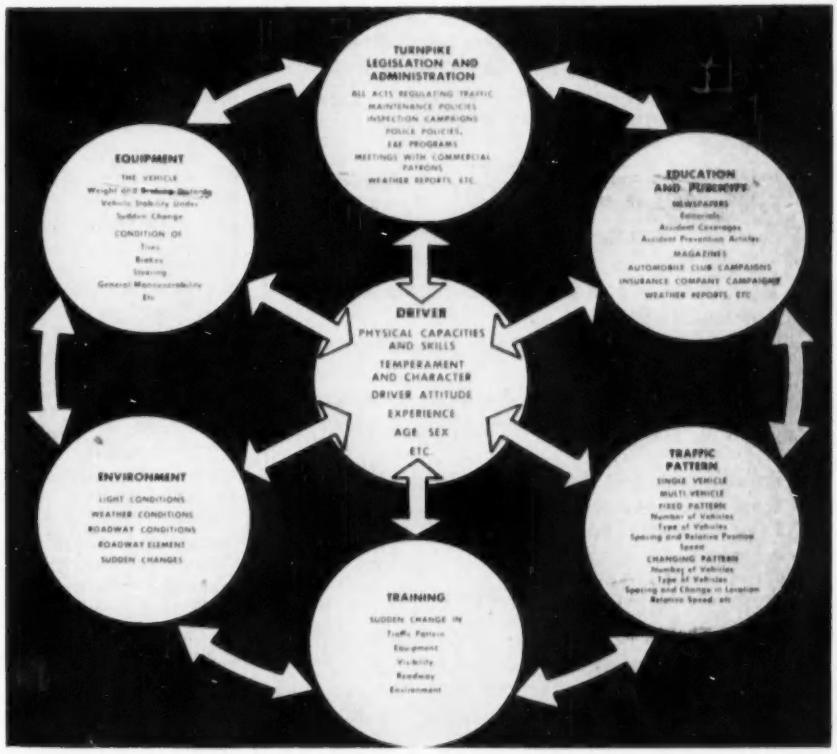
Research Studies Indicate One Way To Prevent Accidents Is to . . .



Design Vehicles Around the Driver

Based on papers by P. C. Ackerman, R. A. McFarland, and A. L. Haynes

See box on page 18

AN AUTOMOBILE should be designed around the driver instead of placing him in it without regard for his capabilities and limitations. Equipment must be devised and operating procedures set up that make it easy for the driver to reach and operate controls and differentiate between them. The driver should be considered as functioning frequently at only partial efficiency—as when fatigued, ill, or hampered by noise, vibration, toxic gases, extreme temperatures, and humidity. Too, he must be protected from injury in the event of accident. If these human factors are allowed for, and the complex interactions between the driver, the vehicle and the environment are taken into consideration, then automobiles can be designed to (1) prevent accidents, and (2) prevent injury in the event of an accident.

Preventing Accidents By Design

Accident prevention has always been an important concern of the automobile industry. By continually improving over-all vehicle control and performance, manufacturers have done much to increase safety. Although the total number of accidents and injuries has increased, during the past 23 years the traffic fatality rate has been reduced 55%, as shown in Fig. 1. In 1954 there were only 6.4 deaths per 100 million miles of travel. This was accomplished despite the increase in traffic load per mile of highway. As shown in Fig. 2, the number of vehicles on the road increased 70% between 1945 and 1952, total miles of annual travel increased 100% while the available highway mileage increased less than 1%.

No doubt driver education, better traffic management, and improved highway design have contributed to this encouraging progress, but mechanical improvements in vehicle design can take most of the credit.

During the last 50 years safety features such as four-wheel hydraulic brakes, blow-out resistant tires, power steering, and stronger headlights have

THIS ARTICLE was based on the following papers presented at the SAE Golden Anniversary Summer Meeting, Atlantic City, June 16, 1955:

Introduction to Discussion on Automobile Safety
P. C. Ackerman Chrysler Corp.

562—Human And Environmental Factors of Automobile Safety
R. A. McFarland Harvard School of Public Health

563—Design Factors in Automotive Safety
A. L. Haynes Ford Motor Co.

Papers 562 and 563 are available in full from SAE Special Publications Department. Price: (each) 35¢ to members, 60¢ to nonmembers.

made automobiles safer. Less evident but probably more significant is the excellent reliability of automobile structures and components. This has been the outgrowth of continuing engineering refinement. Today no new component is added to an automobile until it has been thoroughly tested in the laboratory and in the field.

Preventing Injury By Design

No matter how well an automobile is designed to prevent accidents human error will continue to precipitate them. So during the past years, research has been conducted on how to prevent injury when there is an accident. Safety glass and all-metal bodies are examples of some of the measures already adopted to reduce injury.

Investigations have been intensified recently to learn additional ways of preventing injury. Full scale collisions have been staged to watch the behavior of vehicles and occupants during impact. It's been found that the forces generated during collisions are much greater than expected.

The automobile industry is frequently criticized for not providing greater structural strength to withstand collision with less damage. However, when inertia, deceleration, and the dissipation of kinetic energy are considered, it becomes obvious that the structural bending and yielding forward of the driving compartment greatly moderate the force of impact. Fig. 3 shows how the structure of the modern car reduces the impact reaction and subsequent injury to the vehicle occupants.

A test set-up used to conduct full-scale crash studies is shown in Fig. 4. The crashed car has instruments in it to determine the impact forces developed. Some tests use a barrier wall to simulate a collision with a tree or bridge abutment. The anthropomorphic dummies shown in Fig. 5 approximate humans in size, weight, distribution, and skeletal articulation. They are instrumented to record collision reactions. Joint tensions can be pre-set to simulate human anticipatory reactions, and their skin response will disclose injury-producing contacts with the interior of the car. Crashes are conducted with the dummies both free to move and held by restraining devices. High-speed motion pictures are taken as the crash occurs and these are analysed frame by frame. Fig. 6 is a photograph taken during a crash test.

How much impact and deceleration the human body can tolerate are now being investigated. Fig. 7 shows preliminary results obtained by a USAF research program. It was found that a human being can withstand very high forces, without injury, if he is properly restrained with a seat belt. On the other hand a speed of 15 mph can cause death if the momentum of the head is not checked during rapid deceleration.

In sudden stops that produce deceleration forces near 14 ft per sec sq, passengers must brace themselves to prevent being thrown forward against the windshield, or dashboard and becoming injured. (The average brakes are capable of producing a deceleration up to 26 ft per sec sq without skidding the wheels.)

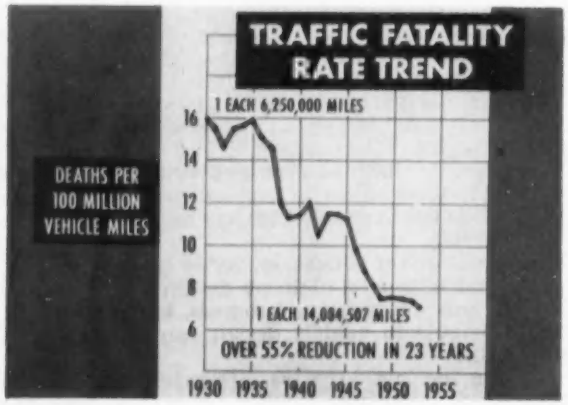


Fig. 1—Traffic fatality rate trend continues downward.

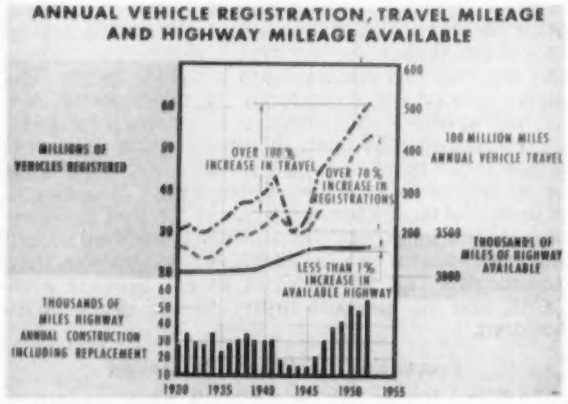

ANNUAL VEHICLE REGISTRATION, TRAVEL MILEAGE AND HIGHWAY MILEAGE AVAILABLE
MILLIONS OF VEHICLES REGISTERED
OVER 100% INCREASE IN TRAVEL
OVER 70% INCREASE IN REGISTRATIONS
100 MILLION MILES ANNUAL VEHICLE TRAVEL
THOUSANDS OF MILES OF HIGHWAY AVAILABLE
LESS THAN 1% INCREASE IN AVAILABLE HIGHWAY
THOUSANDS OF MILES HIGHWAY ANNUAL CONSTRUCTION INCLUDING REPLACEMENT
1920 1925 1940 1945 1950 1955

Fig. 2—Traffic load per mile of highway has constantly increased.

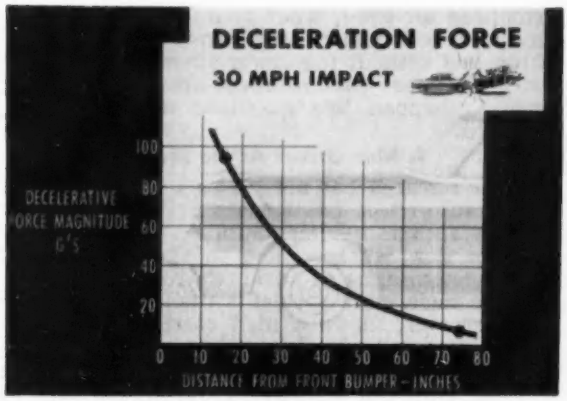


Fig. 3—During collision the front of the vehicle crumples, absorbing deceleration force and protecting the occupant from injury.

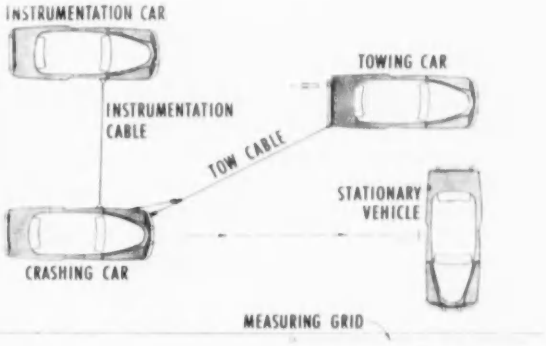


Fig. 4—Schematic of the test set-up used to conduct full-scale crash studies. Stationary vehicle is sometimes replaced by a barrier wall.

Seat belts, properly installed and used, improve the chance for survival and reduce injuries. They prevent the occupant from being thrown out and from hitting uncushioned parts of the vehicle.

At the Automotive Crash Injury Project at Cornell Medical College 2000 case histories per year from seven states are being evaluated. So far they've found that one or more front doors opened in about half of the injury-producing accidents, especially if the car rolled over. In one out of four cases when the front doors opened, the occupant was thrown out, doubling the risk of getting seriously injured.

The automobile industry is cognizant of these findings and many 1956 models will feature special, crash-resistant door locks and seat belts.

These are examples of how, through research and experience, automotive engineers have gained an extensive understanding of mechanical design factors for improving safety. But in one important area—driver behavior—they know very little.

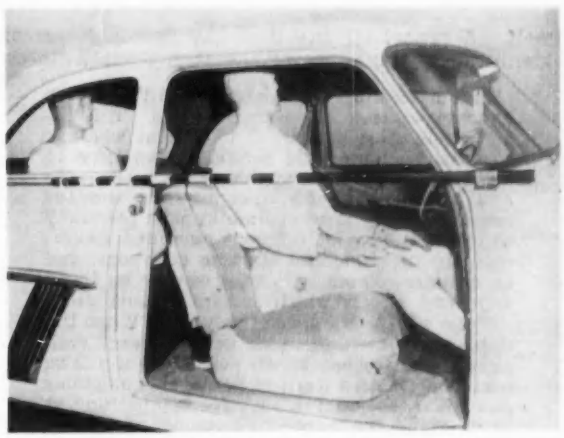


Fig. 5—Anthropomorphic dummies are placed in a test vehicle to reveal what happens to live occupants during a crash.

Evaluating the Human Factor

A logical starting point in analysing human factors in automobile safety is the driving situation

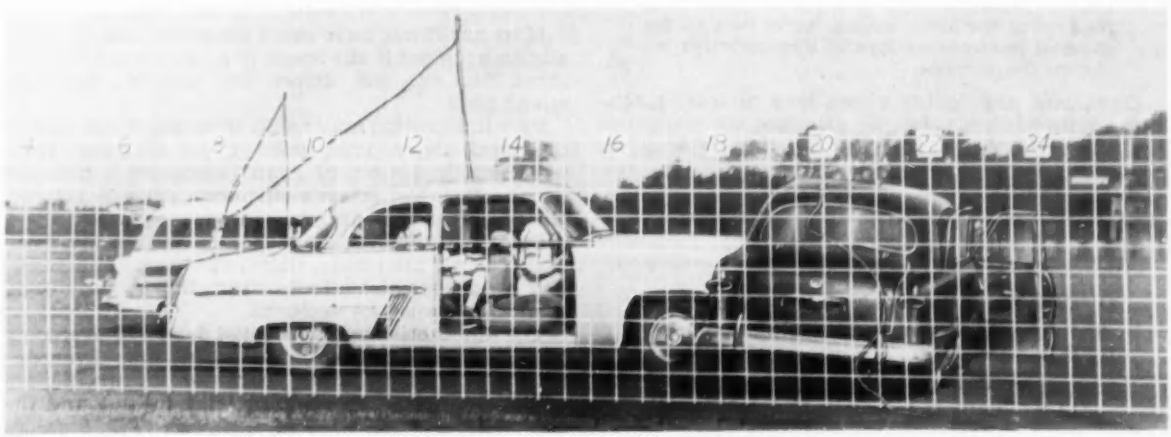


Fig. 6—Photograph of a crash test shows wire grid which is used to indicate distances in high-speed motion pictures.

Search for Safety

HARVARD SCHOOL of Public Health has conducted a broad research into highway safety during the past six years. Studies were initiated by the American Trucking Associations, Inc., the National Association of Motor Bus Operators, and the National Association of Automotive Insurance Companies.

Since 1951 the Commission on Accidental Trauma of the Armed Forces Epidemiological Board, Department of Defense has sponsored research on the human factors in vehicle accidents.

itself. A report by the Highway Safety Research Committee of the National Research Council states:

> The driver must first learn to coordinate both hands, both feet, vision, and hearing. This coordination must be learned to a point where it becomes semiautomatic before he can hope to operate in traffic with any degree of safety. He must also learn to judge changing space-time relationships. He must operate in close proximity to other vehicles of different sizes and speeds, going in the same and opposite directions, and on crossing courses. He must operate on highways and streets which require passing other vehicles with a clearance of only 1 ft. When the time intervals within which he must react, even at relatively low speeds, are considered it will be seen that he must learn to anticipate conditions and situations. If two cars are approaching at 30 mph and one driver loses control when they are 45 ft apart, each driver has 0.5 sec to react. This means . . . that he would just have time to get his foot on the brake, but there would be no possibility of stopping the car in time to prevent a collision. Thus, the factors of foresight, planning, and appreciation of hazards must be involved to a major extent. Probably more continuous attention from moment to moment is required of the motor vehicle driver than of the operator in any other type of transportation including the airplane.

Obviously, any factor which may distract attention, diminish alertness, or decrease consciousness will place the driver in jeopardy. Why the driver

Drivers Are at Fault

OVER 85% of the accidents and 97% of the deaths on the Pennsylvania Turnpike during its first 13 years were caused by driver incompetence or carelessness. Only 14% could be attributed to vehicle failure.

committed an error, what characteristics of man may predispose him to error, what influences both within and without the driver affect his efficiency, and under what circumstances are mistakes more likely to happen, are questions which must be answered.

A Man Drives As He Lives

So far research has not been able to reveal any direct cause-effect relationship between accidents and any specific human limitation such as faulty vision or slow reflexes. And there is no accurate way of determining in advance which persons are likely to have more accidents than others. Tests have, however, shown a high correlation between poor drivers and people who have many contacts with law courts, credit bureaus, and social service agencies, as shown in Fig. 8. Some factors such as youthfulness, low intelligence, and lack of social responsibility appear more significant than physiological characteristics. Evidently a good rule of thumb for determining safe drivers is that "a man drives as he lives." Safe drivers on the whole tend to have average or better-than-average intelligence, to be relatively free of sensory and physical defects, and to be free from emotional conflicts or maladjustments.

It's possible that repeated accidents are related to

Accident Toll

IN 1954 there were approximately 36,000 deaths and over 1,000,000 injuries due to automobile accidents. Direct costs of these accidents were about $4,500,000,000.

the drivers personality and aptitude. However, not all accident repeaters are "accident prone" and a truly accident prone driver might never have an accident. Accurate records and careful research are necessary to reveal accident repeaters and provide a starting point for correction.

Designing Safety into A Vehicle

Most accidents have more than one cause. Usually an accident is the result of a failure to integrate three factors: the driver, his vehicle, and the environment.

Poor integration may result from emotional causes discussed above, from poor driver training, from poor vehicle design, or from temporary conditions which affect the driver's efficiency, such as fatigue, alcohol, illness, or drugs.

Environmental variables such as weather, ventilation, carbon monoxide, noise, vibration, and highway conditions also affect driver efficiency and may eventually cause an accident.

The automotive engineer must design to overcome these human and environmental factors. Even design faults which result in minor inconveniences and discomforts can combine with fatigue and increase the possibility of an accident. Fig. 9 shows the influence of fatigue on visual and psychomotor

reactions. Though a driver may be able to compensate for inadequate design under normal conditions, he may not have time to do so in emergencies.

Questions such as how fast should the brakes operate in relation to the age, sex, size, and strength of the driver, how much "feed back" should be present in the power steering system, and how should the automatic shifting device be designed for greatest ease of operation and standardization, are but a few of the problems the safety-minded designer must solve. Only then can he be sure that design failure was not the cause of an accident.

The concept of design failure is relatively new and unexplored in the automotive field, partly because accident reports have failed to identify this source as a cause of accidents. Design failures may be so subtle that those responsible for reporting accidents may not even be aware of them, particularly if they are not trained to recognize them.

An automobile and its components must be designed in terms of human capabilities and limitations. In other words, it must be designed from the driver outward, with instruments and controls considered as extensions of the driver's nervous system and body.

An example of this idea is shown in Fig. 10, which is a block diagram for a power steering system. The driver is considered as the feed-back in a closed-loop servomechanism. The feed-back is, of course, a function of the reaction time of the individual, his psychological make-up, his anticipatory reactions, and similar factors. We need further data on these human factors and have enlisted the resources of the human engineering sciences.

The major areas of automotive design to which the biological and psychological sciences can contribute most effectively are as follows:

(a) the layout of the driving area for comfort and efficiency including allowing for variations in human body size,

(b) the design and arrangement of instruments and controls for operating under normal and emergency conditions,

(c) the control of toxic factors in the environment,

(d) the protection of the driver in the event of sudden deceleration or collision.

Driver's area—Designing the driver's area in a vehicle for the utmost safety requires determining

Auto Makers Aid Study of Crashes

CORNELL University will expand its automotive crash injury research program under two new grants of $200,000 each from the Chrysler Corp. and the Ford Motor Co.

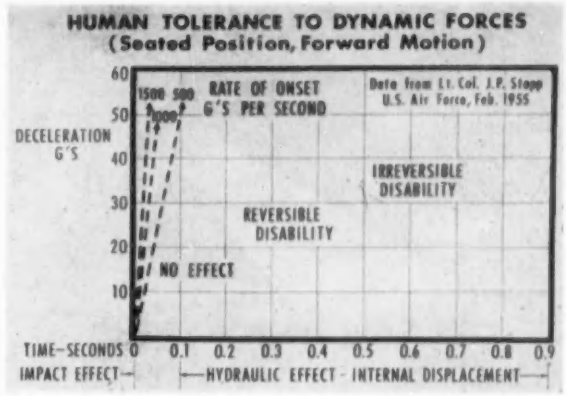


Fig. 7—USAF research preliminary results show the dynamic forces that can be tolerated by the human body.

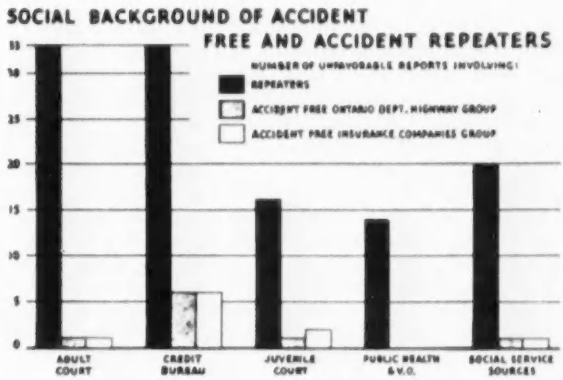


Fig. 8—Case histories of taxi drivers indicate that accident repeaters have a much more unstable social background than accident free drivers.

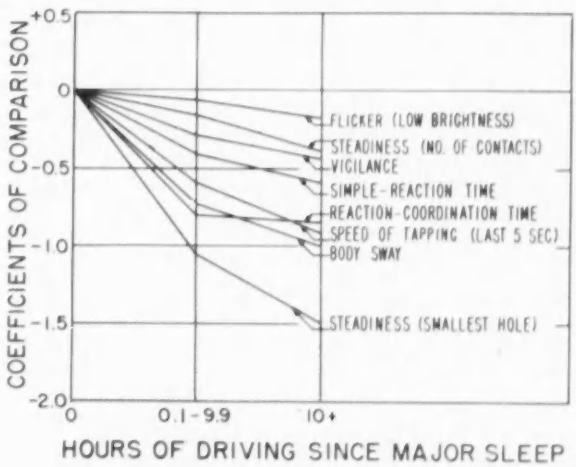


Fig. 9—Driving ability decreases rapidly as the driver becomes tired from prolonged driving without rest.

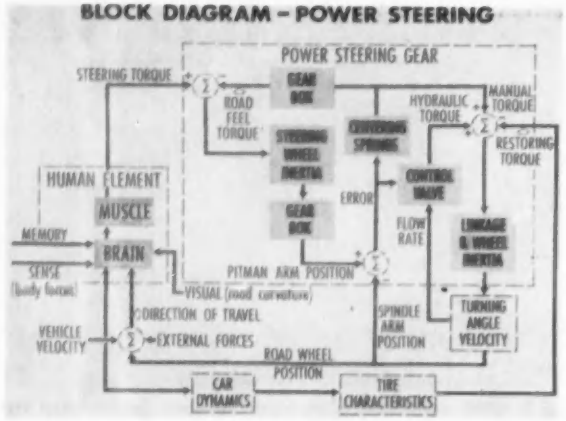


Fig. 10—The driver is considered as the feed-back in a closed-loop power steering servomechanism. Feed-back is a function of reaction time, anticipation, and other psychological factors.

the full range of size of the driving population. Once this is known, human capabilities and body size can be considered in the original design of controls, instruments, window areas, and seats.

Any control that is unnecessarily difficult to reach and operate, any instrument that is difficult to read, any seat inducing poor posture or discomfort, or any unnecessary obstruction to vision may contribute directly to an accident. Also the cumulative effects of such difficulties are sure to induce fatigue in the driver and may lead to an accident.

Ventilation—Driver performance tends to deteriorate significantly above 83 F at 100% humidity. Optimum comfort zone is between 68 and 78 F with a relative humidity of 30 to 70%. Also 35 to 40 cfm of fresh air should be supplied per individual at velocities of between 20 and 60 fpm to maintain a sense of freshness without undesirable drafts.

Exhaust system—Dangerous concentrations of carbon monoxide may come from leaks in the exhaust system. Exposure to 0.10% carbon monoxide can be dangerous to life after 1 hr. Even as little as 0.01%, although having no perceptible effects for several hours, should not be permitted over long periods. In general, exhaust systems have been made leak-proof, but drivers should realize the necessary of airing vehicles standing with idling motors.

Noise and vibration—Noise and vibration in most passenger cars are sufficiently low to constitute no safety hazard. However, some trucks and buses have over-all sound levels up to 95 db. This will tire a driver rapidly and prevent his hearing warning sounds from other vehicles. It is a real challenge to automotive designers to reduce noise and vibration. Soft mounts, vibration damping compounds, silencers, and mufflers are methods in common use.

Lights—The design of automobile lights should take into account the basic characteristics of human vision. At low illumination the acuity of vision suffers, color values change, and relatively greater contrasts between object and background are necessary. Age also must be considered, with greater intensities of light required for older drivers.

Accident rates at night have been reduced when artificial lighting has been increased. Improvements have also resulted from larger, stronger-beamed tail lights, locating them higher on the vehicle, and increasing the number per vehicle.

Wheel Bearing Lubrication . . .

. . . gets boost through issuance of recommended practices by NLGI. Universal adoption should bring order out of what has been a chaotic situation.

Based on paper by **P. V. Toffoli, Jr.,** The Pure Oil Co.

WHEEL bearing lubrication requires more skill than any other lubricating operation, but conflicting manufacturers' recommendations rather than uniform sound practice has ruled, resulting in a flood of undeserved complaints about greases.

Recognizing the need to eliminate the confusion, the Technical Committee of the National Lubricating Grease Institute established a subcommittee to develop, if possible, recommended practices for the lubrication of front end bearings. Work was started in 1952 and the procedures arrived at with the approval of car, truck, and bearing manufacturers have been published as recommended practices.

It is the mishandling and improper application of grease and not the quality of the product that has caused most of the headaches. Grease can become contaminated by introduction of foreign matter during storage and application, by contact with old grease and water. Poor inspection or improper seating or adjustment will create trouble. Failure to grease immediately on cleaning may cause corrosion of the bearing before re-lubrication. Still another cause of failure is the use of grease in excessive amounts.

Manufacturers' recommendations have been of little value because they differ so widely as to greasing interval, quantity of grease, and packing procedure. Completely contradictory and irreconcilable advice is not uncommon, in spite of the close similarities of the wheel bearing assemblies.

Adoption and application of the NLGI recommendations and more uniform recommendations by both

automotive and petroleum industries as to interval, type of grease, and amount to be used, should give the customer the best from both lubricants and available parts, and reduce needless and expensive failures. (Paper "Taking the Confusion Out of Wheel Bearing Lubrication" was presented at SAE Golden Anniversary Summer Meeting, Atlantic City, June 15, 1955. It is available in full in multilith form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

Engineering Change . . .

. . . can be a tool of cost reduction. It is also a means to standardization. The "block control" method of making changes is gaining favor.

Based on report by **W. K. Perry**, Bendix Aviation Corp.

ENGINEERING change procedure in today's highly competitive aircraft market falls into two categories. The first and most familiar is the single change introduced because it enhances product quality or manufacturing efficiency. The second is the "block control" change whereby a group of related changes are stored up to be released to the production floor simultaneously.

The block control method enables a manufacturer to minimize the change activity of his production departments. It also allows him to revise his product in response to controlled batches of changes instead of altering type with one change. Change now controls model type instead of the reverse.

Airframe manufacturers find block control to be indispensable. Producers of engines and propellers also use this method. One engine builder is applying it to his project design phase for the purpose of improving control over the engineering of the product.

Accessory and instrument makers are not using block control in the strict sense. Some make changes in groups of products rather than by blocks of changes; others find it necessary to introduce changes strictly on a requirement basis.

Block control applies only to "major" changes. These are major deviations made by engineering only and which definitely affect unit interchangeability. It usually falls to production control to determine effectivity, which depends on the production schedule, the customer, and the parts situation. Minor changes, having no affect on interchangeability, may be introduced at any time set by production control. Even under block control there are times when a mandatory variation change becomes necessary to make a unit function. Here, engineering direction rather than production control determines effectivity.

Whether the changes are block-controlled or not, the inception and submission of change orders follows a similar pattern. A marked drawing is presented to the approving authority. If the change is complex it may be supported by a prototype to prove the point. Then comes evaluation of the change, varying with the type of product.

With airframe manufacturers, major users of block control, decision on change generally resides in the production engineering group. Accessory and instrument producers, who find single-change control better suited, put the decision up to higher management levels. The former spend three to four times as much effort on engineering changes during the production period as they do during primary engineering. Accessory and instrument makers, on the other hand, make only about 10% of engineering changes after units are in production.

Management is taking more and more responsibility for authorizing engineering change. This would indicate a recognition of the close relationship between such change and the profit position of operations. It is a move spurred by the heightening of competition within the aircraft industry.

(This article is based on the secretary's report of panel on Engineering Changes in a Competitive Market held as part of the Aeronautic Production Forum of the SAE National Aeronautic Meeting, New York, April 21, 1955. It is available together with six other panel reports as SP-311 from SAE Special Publications Department. Price: $1.50 to members, $3.00 to nonmembers.)

Panelists who led the discussion on which this article is based were:

M. F. McCammon, Leader
Eclipse-Pioneer Division, Bendix Aviation Corp.

W. K. Perry, Secretary
Eclipse-Pioneer Division, Bendix Aviation Corp.

R. L. Bortner,
Republic Aviation Corp.

George Deaney,
Weston Electrical Instrument Corp.

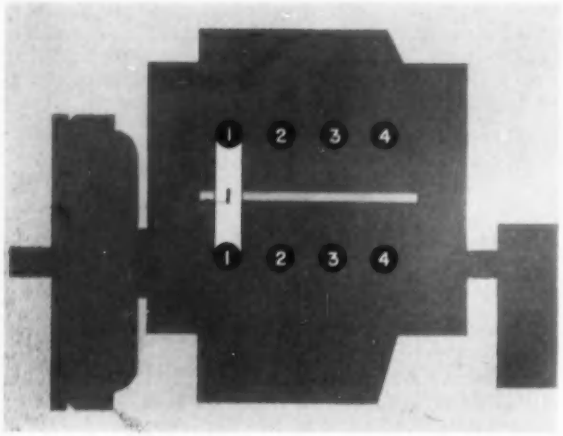
Grayson Grossnickle,
Westinghouse Electric Corp.

George A. Higgins,
The Glenn L. Martin Co.

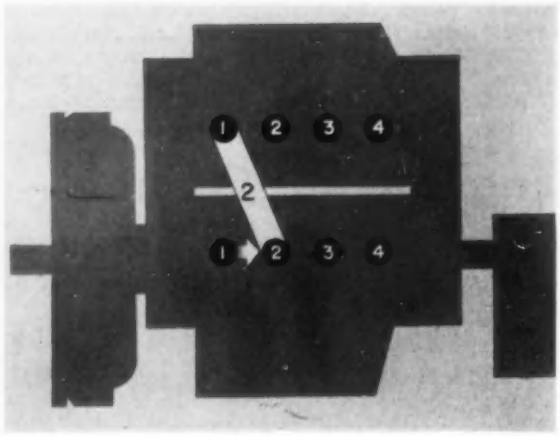
W. W. Hiland,
General Electric Co.

T. A. Sandstrom,
Thompson Products, Inc.

F. J. Siponen,
Fairchild Engine and Airplane Corp.



SHIFTING SEQUENCE: Both units start in first gear giving a combined first-gear Twin Hydra-matic ratio.



LOWER UNIT shifts to second gear because the output shaft is being driven faster. This is second gear.

GM's Twin Hydra-matic Gives

GM's Twin Hydra-matic transmission has many advantages over the gear-type transmission and the single automatic transmission, particularly when it is used in heavy-duty trucks and buses. The engine can be kept turning at a high rpm at all times, which allows near maximum horsepower at all times. The two four-speed transmission units permit seven forward gear ratios and do not require breaking the power from the engine to the wheels during shifting. Thus, a vehicle with the Twin Hydra-matic can have higher average speeds without an increase in top speed.

Other design points of the GM Twin Hydra-matic are as follows:

1. The transmission shifts during full power, thereby giving gains in performance, economy, and acceleration.

2. The transmission automatically selects the proper ratio for maximum performance more efficiently than an inexperienced or fatigued driver can do it manually.

3. The driver has control over the transmission by the use of the manual "Hold" position on the selector lever. This enables the driver to anticipate road problems and prevent the transmission from shifting until he wants it to.

4. A large fluid coupling provides high efficiency and good fuel economy.

5. Weight and size of the transmission do not exceed present heavy-duty transmission and clutch combinations.

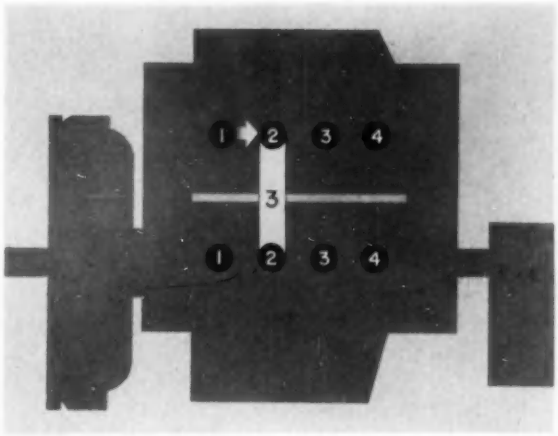
6. The transmission has approximately 20% gear splits and adequate ratio coverage with a reduction unit.

7. The transmission gives good engine braking by downshifting through each gear and by the use of the manual "Hold" position. This is essential for down-hill runs.

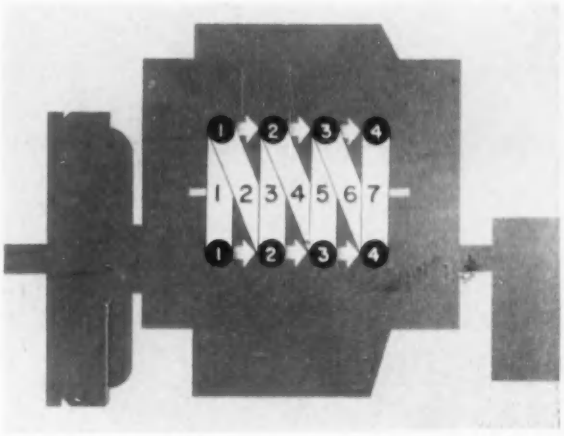
8. The transmission is used with both gas and diesel engines in the 200-hp range and will handle 600 ft-lb of torque.

9. The transmission has a long life and keeps maintenance costs low due to the split in torque and the overdrive through each transmission unit.

10. A power take-off opening is provided on the reduction unit.



HIGHER ROAD SPEED causes upper unit to shift to second gear. Combined second gear ratio in both units gives third.

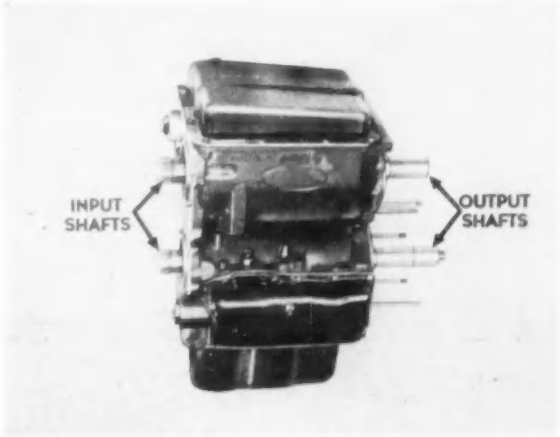


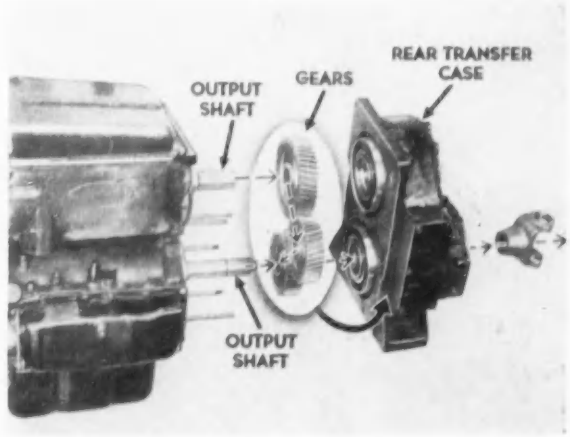
ALTERNATING SHIFT sequence continues until fourth gear in each unit is accomplished, giving seventh gear.

Transmission Full-Power Shifts

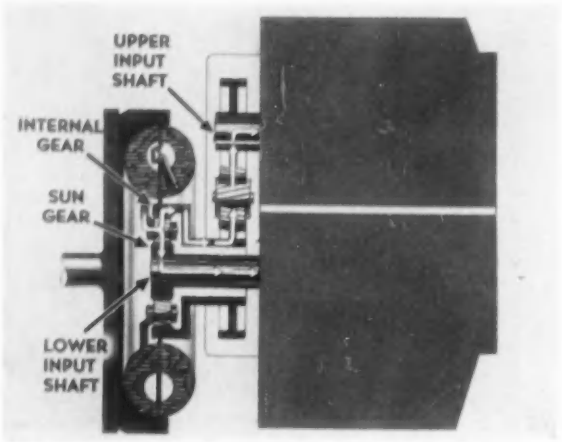
L. T. Flynn and F. W. Brede, GMC Truck and Coach Division

Based on paper "GM Twin Hydra-matic Transmission" presented at SAE Golden Anniversary Summer Meeting, Atlantic City, June 16, 1955.

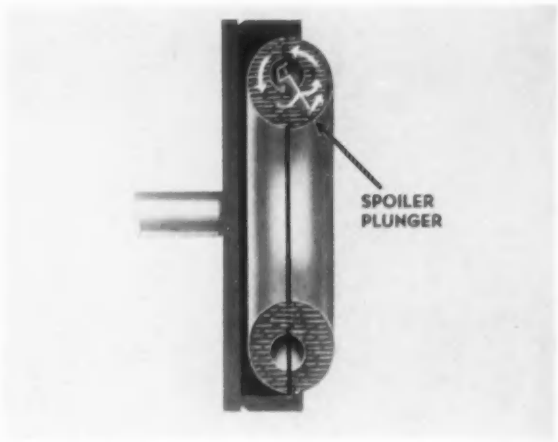




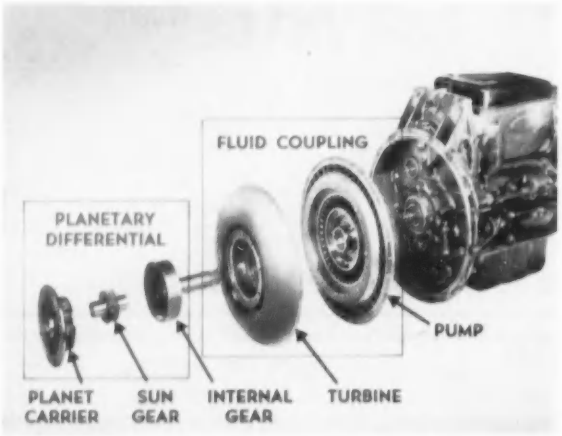
GM's TWIN HYDRA-MATIC TRANSMISSION has two medium-duty truck Hydra-matics, one above the other, which increases the number of ratios and splits the operating torque. Output shafts run at different speeds connected by a gear train. One unit shifts ahead of the other, when being driven faster, because each unit has its own governor geared to the output shaft which controls the shift points.



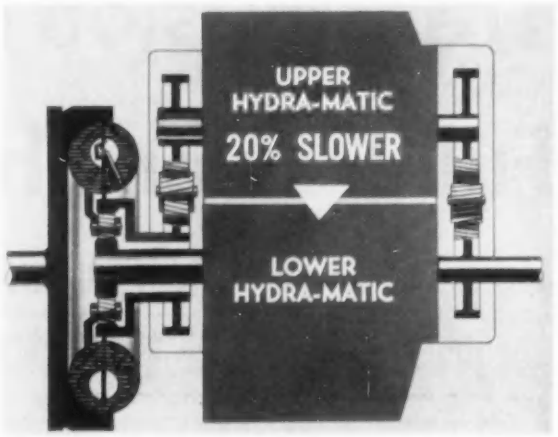
DIFFERENTIAL GEARS connect the input shafts and handle the differential input shaft speeds when one transmission shifts ahead of the other. Differential also speeds up the input rpm, reducing input engine torque and splitting it approximately equally between the units. Gear set overdrives the engine allowing the units to operate in their most desirable speed range.



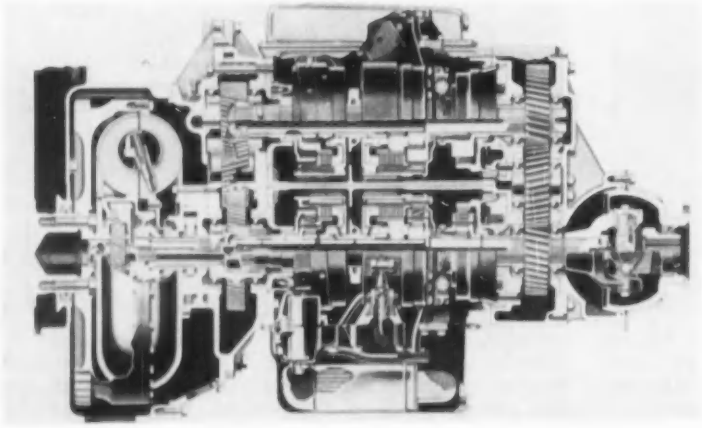
FLUID COUPLING was designed as large as possible to provide maximum performance and economy. A "spoiler" is necessary to reduce its efficiency at idle speeds. Spoiler is a centrifugal valve between each of the coupling vanes which upsets oil flow and decreases efficiency. As speed increases centrifugal force causes the valves to retract, giving full coupling efficiency at 800-900 rpm.



EXPLODED VIEW of differential and fluid coupling shows the actual gears and the turbine and pump. The gears fit inside the fluid coupling components.

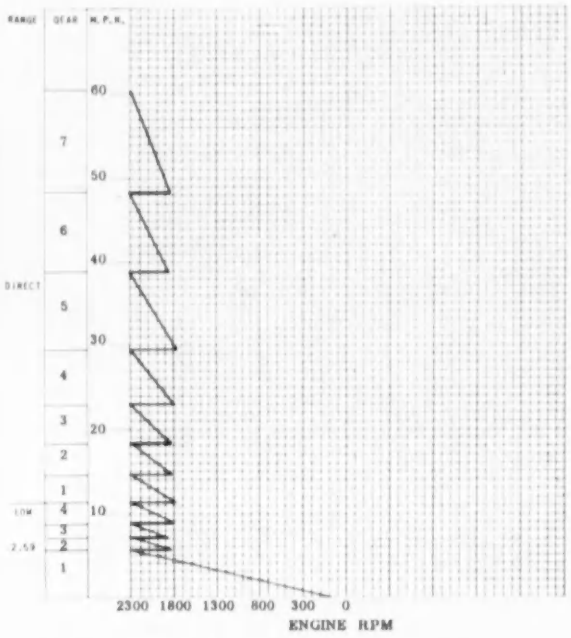


BASIC COMPONENTS are two four-speed Hydra-matic units, a gear train connecting output shafts, a differential gear set as input to two transmissions, and a fluid coupling.



POWER FROM THE ENGINE drives the pump half of the fluid coupling (at far left). This, in turn, drives the turbine half of the coupling, which drives the planet carrier of the differential gear set. Planet carrier pinions drive both the sun gear and the internal gear. The sun gear drives the lower Hydra-matic unit; the internal gear drives the upper unit through the gear train. Power on the output shafts of the two transmission units is combined by the gear train and delivered to one output shaft.

HOLD POSITION is provided to (1) prevent upshift of the transmission in any gear, and (2) raise downshifts to maximum rpm without overrunning the governor when the shift is completed. For example, when approaching an upgrade, the driver places the selector lever on "Hold" to obtain high downshifts with maximum engine performance. After reaching the top of the grade, the driver will then return the selector lever to "Drive" until the truck gains the desired downhill speed. He would then place the lever on "Hold" again to hold that road speed and use the engine for braking.



SHIFT CHART for the diesel Twin Hydra-matic shows the gear steps with a standard two-speed reduction unit using a 2.59 LO. The first column shows the reduction unit position and the second shows the gear. Note the uniformity of the gear steps and the small drop in engine rpm between each gear change. The engine is always operating between 1800 and 2300 rpm. The shift chart for the gasoline Twin Hydra-matic is similar with different engine speeds.

REDUCTION UNIT MODEL		STANDARD 2-SPEED RU-23	OPTIONAL 3-SPEED RU-31: OPTIONAL 2-SPEED RU-22	
REDUCTION UNIT RATIO	LO 2.59:1	HI 1.00:1	LO 2.00:1	CR 3.87:1
TRANSMISSION GEAR				
1st	7.51	2.90	5.80	11.22
2nd	6.06	2.34	4.68	9.05
3rd	4.82	1.86	3.72	7.19
4th	3.76	1.45	2.90	5.61
5th	2.85	1.10	2.20	4.25
6th	2.31	.89	1.78	3.44
7th	1.84	.71	1.42	2.74
Rev.	8.32	3.21	6.42	12.42

DIESEL GEAR RATIOS: Seven forward gear ratios of the diesel Twin Hydra-matic are shown in the column marked HI. Due to the overdrive characteristics of the differential, the first GM Twin Hydra-matic ratio is 2.90. (Both units in first gear.) Second gear ratio of 2.34 is accomplished by the lower transmission's shifting to second gear while the top unit is in first gear.

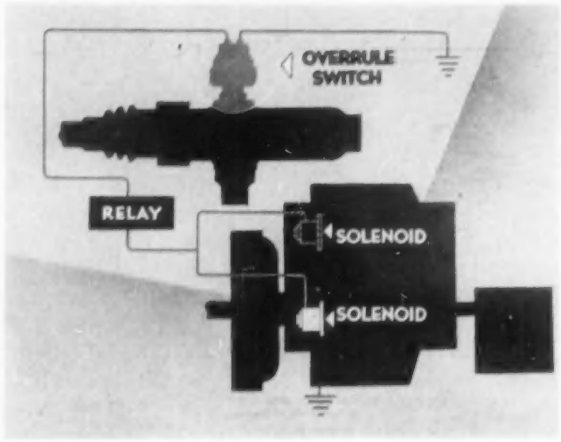
Adding a two-speed reduction unit gives the ratios shown in the columns marked LO. With a 2.59 reduction unit ratio, 11 effective forward speeds are obtained. With a reduction unit ratio of 2.00, 10 effective forward speeds are obtained.

Adding a three-speed reduction unit gives the ratios shown in the columns marked CR (Creeper) and LO 2.00. Using CR in the three-speed reduction unit gives 13 forward speeds, using LO gives 10. The three-speed reduction unit never requires more than one shift to get all ratios. For example, starting in Creeper, the Twin Hydra-matic would automatically shift seven gears. Then with the reduction shifted manually to HI, the Twin Hydra-matic would automatically shift six gears. It is never necessary to shift from Creeper to LO and then to HI, due to the duplication of ratios.

REDUCTION UNIT MODEL		STANDARD 2-SPEED RU-23	OPTIONAL 3-SPEED RU-31: OPTIONAL 2-SPEED RU-22	
REDUCTION UNIT IN	LO 2.59:1	HI 1.00:1	LO 2.00:1	CR 3.87:1
TRANSMISSION GEAR				
1st	9.55	3.69	7.38	14.28
2nd	7.58	2.93	5.86	11.34
3rd	6.16	2.38	4.76	9.31
4th	4.88	1.81	3.62	7.00
5th	3.62	1.40	2.80	5.42
6th	2.87	1.11	2.22	4.30
7th	2.33	.90	1.80	3.48
Rev.	10.61	4.10	8.20	15.87

GASOLINE GEAR RATIOS: On the gasoline Twin Hydra-matic the rear gear train is inverted. This drives the upper unit 26% faster causing the upper unit to shift first and giving a new set of seven ratios. (See column HI.) The ratios are different for gasoline models because the gasoline engine governed speed is 2800 rpm while the diesel's is 2300 rpm. The ratios compensate for the different engine speeds.

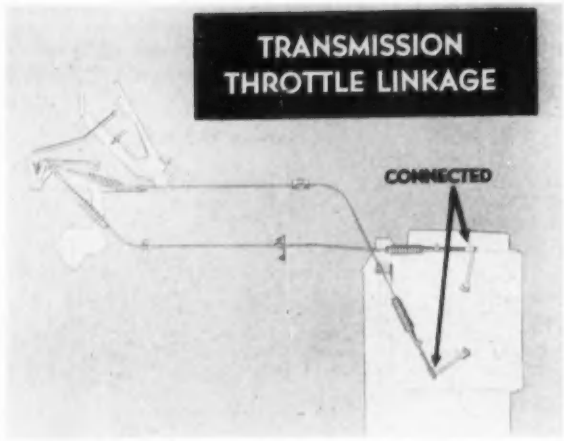
The two and three-speed reduction units are the same as those used with the diesel but the numerical ratio is changed. The ratios in each of the reduction unit ranges are shown.

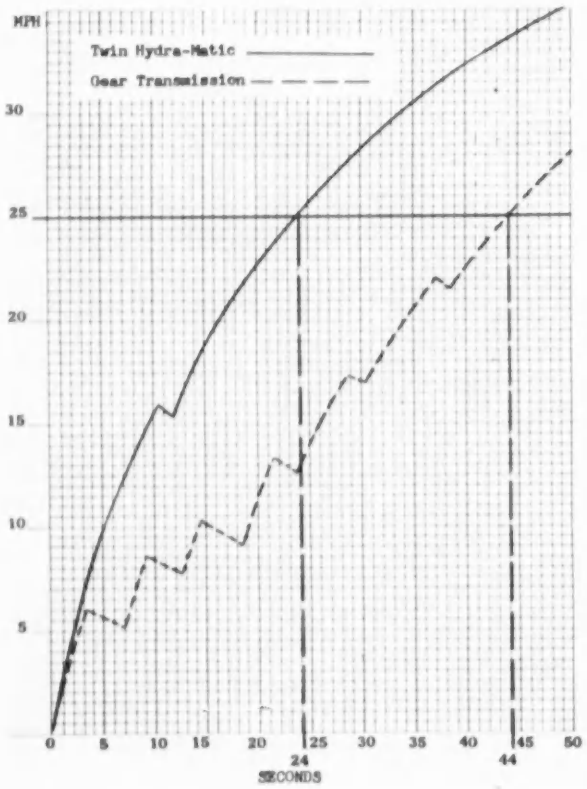


TO SHIFT THE REDUCTION UNIT a means for braking the power had to be provided because there is no conventional clutch. A solenoid is energized which pulls a valve and neutralizes the transmission. The signal comes to the solenoid from a switch mounted in the reduction unit shift control rod. Pressure is applied to the reduction unit shift lever, causing the switch poppet to ride up the ramp, closing the electric circuit to the solenoids. While synchronization of the shift is being made there is a constant pressure on the synchronizer and reduction unit shift rod, keeping the transmission neutralized.

Upon completion of the synchronization, the pressure disappears, the poppet centers itself and de-energizes the solenoid. The solenoid spring then returns the manual valve to the drive position. The Twin Hydra-matic will automatically select the correct ratio to match the new reduction unit ratio, taking into account road speed and throttle position.

TRANSMISSION THROTTLE LINKAGE synchronizes the external controls. One set of the controls is connected to the carburetor on gasoline models, and to the governor on diesel models. The accelerator pedal is also connected. This ties the engine, throttle, and transmission together.





COMPARING A GEAR-TYPE TRANSMISSION with the GM Twin Hydra-matic, the Twin Hydra-matic accelerated to 25 mph in 24 sec. The gear transmission and auxiliary in the same truck required 44 sec. Vehicle gross weight was 77,000 lb. Engine was the GM 6-71 diesel. With gross vehicle weight reduced 40,000 lb, the gear transmission took 34 sec to reach 25 mph, which is still 10 sec longer than the Twin Hydra-matic with 77,000 lb.

The vehicle with gear transmission traveled 1500 ft in the first minute, starting from standstill. The Twin Hydra-matic traveled 2200 ft—a gain of 700 ft.

This increase in acceleration without an increase in engine hp is a big advantage in traffic and it saves fuel.

(Complete paper on which this abridgment is based is available from SAE Special Publications Department. Price: 35¢ to members, 60¢ to non-members.)

T C A finds Viscount:

Slightly Foreign . . .

. . . but well adapted to Canadian Service

J. T. Dyment, Director of Engineering, Trans-Canada Air Lines

Based on paper "The Vickers' Viscount on Trans-Canada Air Lines' Routes" presented at SAE Golden Anniversary Aeronautic Meeting, New York, April 19, 1955.

THE Vickers' Viscount differs in many respects from the majority of current American airplanes.

The wing structure, for example, differs radically from the multi-spar type commonly used on this continent. The Viscount has a single main spar with leading and trailing edge spanwise shear beams. In addition to main ribs, the wing has a series of closely spaced chord-wise formers with no spanwise stringers (Fig. 1).

The windows and doors are of novel shape, being designed to provide the theoretically best shaped cutout in a cylindrical form. They are elliptical with the major axis being the root of two times the minor axis (Fig. 2). The windows are the largest in the field, being roughly 26 by 19 in.

The doors, which we regard as unnecessarily large, are sealed by compressed air filling an inflatable seal when the handles are turned to the locked position. Should the air system fail, a selector valve permits air from the pressurized cabin to maintain pressure within the seals. Our preference is still for inward opening doors, yet we must admit that the sealing system has given no trouble even under winter conditions.

Elevators, rudder, and ailerons are operated by push-pull rods rather than cables. This is typically British practice. It has been found very satisfactory as it eliminates low-temperature unequal-contraction problems. The double slotted flaps are operated electrically to pre-select positions. In case of a balked landing they retract automatically to the optimum position for a climb-out as the throttles are advanced. Specifically, they move from the 47 to 40 deg position.

The landing gear has one very fine feature. The Dunlop disc brakes are equipped with Maxaret anti-skid units. These units reduce landing distance considerably by permitting the maximum braking effort to be exerted without skidding. They function very effectively even on runways with intermittent dry and icy spots. The landing gear is not a free-fall and lock type and so leaves something to be desired. However, it approximates this type so closely that we believe it could be modified by simple means to so class. The nose-wheel steering is duplicated with a control for each pilot.

Fuel is carried in crash-resistant synthetic rubberized nylon fabric tanks, one tank for each engine with the usual cross-feeds. These tanks can be filled from the top of the wing, but it is unnecessary. At all routine stops they are filled from a single point in the lower surface of the wing at the rate of 150 Imperial gpm (Fig. 3.) An automatic device prevents over-filling.

Three engine-driven Godfrey Roots-type cabin superchargers provide air for pressurization at a rate of about 75 lb per min at 20,000-ft altitude. A two-stage intercooling or refrigerating system provides a means for cooling air from the cabin superchargers. The supercharger delivers air whenever the engine is running and the excess is discharged to the atmosphere through automatically controlled spill-valves. Any single supercharger will maintain full cabin pressure. The system maintains sea level conditions in the cabin up to an aircraft altitude of 15,000 ft, or a cabin altitude of 8,000 ft at 30,000 ft. This cabin differential pressure of 6.5 psi is a bit higher than current American differentials.

Wash basin taps are common spring-loaded commercial household taps. (In 18 years of airline ex-

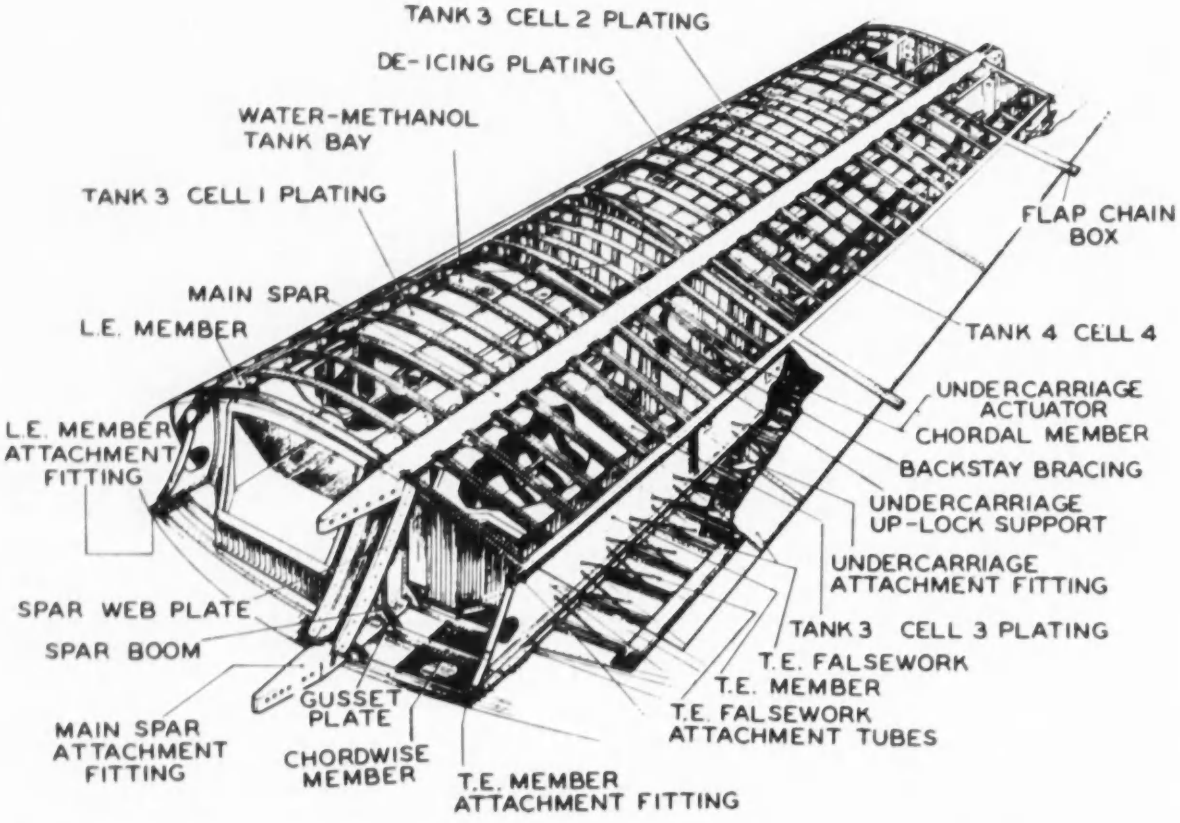


Fig. 1—Inner plane structure of the Vickers' Viscount showing the single main spar construction with leading and trailing edge spanwise shear beams. The chord-wise formers are also shown.

perience no airplane manufacturer has ever designed a water tap that didn't leak, refuse to shut off, corrode, or have some other basic defect.)

Unlike most American turboprops, the Dart has the fuel control unit interconnected mechanically with the propeller governor. As the throttle, or power lever, is opened, the governor is set to a higher speed and the throttle opens to give the required fuel flow. It sounds simple, but actually the design of this interconnecting system to match the power-absorbing characteristics of the propeller with the power-producing characteristics of the engine was quite complex for Rolls Royce. As far as the airline is concerned, once the initial adjustments are made at the time of engine installation, there is no need to change unless the fuel control unit or governor are altered.

The mechanical interconnection of fuel flow and rpm are designed for air temperatures below standard. It is necessary at first to trim back the fuel manually for temperatures above standard to keep the turbine inlet temperature from being exceeded. At our request, Rolls Royce has recently developed a means for doing this mechanically, thus relieving the pilot.

A very simple yet functional cockpit layout has been achieved by substituting a considerable number of the more compact American switches and instruments. This has resulted in making the Viscount basically a one-man airplane which can be flown completely from the left or right seat without a flight engineer. There are approximately 145 fewer controls, switches, warning lights, and instruments than in the most typical of our four-engined transports. (Boeing is said to have a four-engined jet with still fewer controls—which is good news). A designer starting from scratch should be able to improve on our Viscount. However, we believe the current Viscount cockpit is much the simplest four-engined one in the field.

Our primary objective in cockpit design has been to simplify the pilot's job. We think this can be achieved better by concentrating on the reduction of things the captain has to perform manually, or think about in an emergency, than by adding another human element. We hold that the gross weight is not a significant factor in deciding the essentiality of a flight engineer. He is needed in some current four-engined transports, but only because an insufficient number of things are controlled automatically

and because they were conceived with the idea that a flight engineer was essential because of their gross weight. Turbine power offers the CAA a fine opportunity to revise requirements so that the necessity of a flight engineer will be based on cockpit design rather than on gross weight. Our North Star is simpler to fly than its contemporaries and the Viscount is even simpler.

Noise measurements indicate that the Viscount is comparable to the DC-3. To say that it is noiseless and vibrationless is talking poetic license. The noise level at beginning of take-off is lower than that of most reciprocating-engined aircraft. The noise is of a different type and novel when first heard, particularly when taxiing.

We have never been satisfied with any airplane and the Viscount is no exception. There are many items which can be improved from an operating and maintenance standpoint. However, it has fewer "bugs" so far than our previous airplanes.

(Paper on which this abridgment is based is available in full in multilith form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

Discussion

A. E. Raymond, Douglas Aircraft Co.

What is Trans-Canada's practice with respect to holding fuel?

J. T. Dyment

Practice with the Viscount is the same as for other airplanes. The most critical route segment is Toronto-New York. This is an international flight and passengers must be landed at a port of entry because of customs and immigration services. On occasion this necessitates carrying sufficient fuel for round-trip flight. TCA's fuel reserve is generally for 1 hr of holding over New York, plus fuel to an alternate landing, plus a normal 1-hr reserve.

H. L. Hibbard, Lockheed Aircraft Corp.

Do you have any relative figures on sound level?

J. T. Dyment

Sound level measurement methods similar to those used by Douglas show that cabin noise levels are almost identical to those of the DC-3 or the back end of the Lockheed Super Constellation. In the plane of the Viscount's propeller, at the front row of seats, the noise is quite a bit above the rest of the cabin as might be expected. The Viscount may seem quieter to passengers than other aircraft, due to the lower vibration of the turbines.

John Steele, Wright Aeronautical Division, Curtiss-Wright Corp.

What are the limitations on wing spar life?

J. T. Dyment

Tentative limitations of 12,000 hr have been set in Australia, pending collection of gust records. In Europe it looks like 20,000 hr. TCA has asked Vickers for a 40,000-hr spar life and expects eventually to get it. Spar limitations will vary with the part of the world where the airplane is operated because of the difference in frequency and severity of gusts.

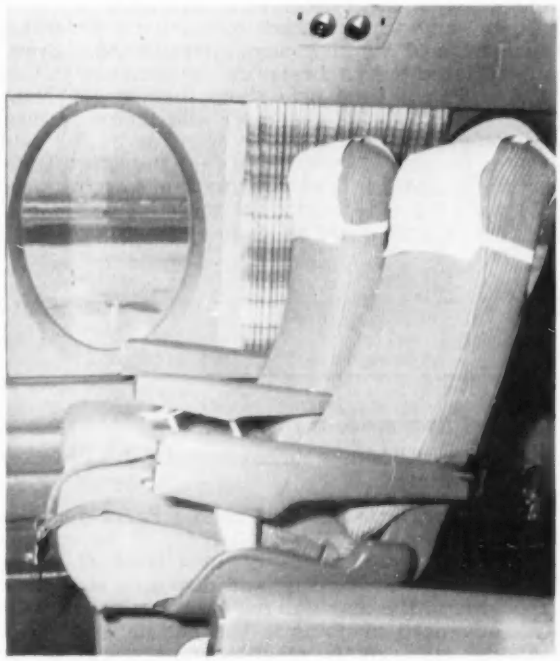


Fig. 2—Oval windows and doors are a feature of the Viscount.

Fig. 3—Fuel is loaded at a single point in the lower wing surface.

Chipless Production

Chipless production processes save material, floor space, and labor. They have rapid cycle times, give close tolerances on parts, and give good finishes. In many cases chipless production is the only method by which a particular part can be manufactured. Here are the latest developments in six chipless production methods:

Cold Working in Presses

There are four different methods of cold working metals in presses. In the order of increasing pressure these are: (1) sizing, (2) flat swaging, (3) coining, and (4) extrusion. Until recently only the non-ferrous materials, such as aluminum, copper, tin, and brass could be cold worked. With the advent of stronger and more powerful press equipment, plus better tool steels and tool lubrication, the cold working of steel became possible.

Almost every manufacturer makes or buys parts made on headers. This type of operation makes him wonder how to utilize the cold working technique on large and differently shaped parts. Some years ago the Delco-Remy Division of General Motors Corp. began using rotary swagers to round up steel tubing after it was formed on a tube mill.

At the same time methods of making a generator frame by cold working were investigated. Eventually this led to a cold extrusion process now in use. At the present time pole shoes, hollow generator shafts, clutch shells, generator and motor frames, and commutator parts are being made by the cold forming process. It was found that the effort, time, and money spent in investigating cold working were paid back by a reduction in material and labor, whenever a part could be made by this process.

Heading

Recently the need for greater quantities of parts have made cold heading a practical production method. When only a small number of parts are needed, conventional machining or hot forging is used. Switching from hot forging to cold heading gives several advantages:

1—Material is saved,

2—Tool or die life is prolonged due to working the metal at room temperatures instead of 2100 F,

3—Parts can be given better finishes and closer tolerances,

4—Less floor space is required,

5—Manpower is used more efficiently due to faster cycle times.

Making intricate parts by header operations has been encouraged by the availability of better tool steels and new methods of heat-treating them. Also feeding, transferring, and disposing stock and parts around the machine has been improved. The most advanced machine is the bolt maker which feeds coil stock to the machine, makes the bolt or screw, then threads it before disposing of it.

W. P. Bowman, Delco-Remy Division, GMC

Based on secretary's report of panel on Chipless Production held as part of the Production Forum at the SAE Golden Anniversary Production Meeting, Cincinnati, March 14, 1955.

Saves Time and Money

Rotary Swaging

Rotary swaging is a process of shaping a part with many blows applied by rotating dies. Although this makes the completed part round, within this limitation, swaging is applicable to a wide variety of pointing, tapering, reducing, sizing, and assembly operations. There are several advantages of swaging instead of machining:

1—Material is saved,

2—Cycle times are faster,

3—Parts can be given smoother surface finish and closer tolerances,

4—Operators don't need as much skill as a machinist.

Rotary swaging may be done either hot or cold. Cold swaging finishes a part better and prolongs tool life. But as the material is swaged it becomes longer, so allowance must be made in the tools. Parts as small as 0.015 in. diameter and as large as 14 in. diameter have been swaged successfully.

Rotary swaging can be equipped with air, hydraulic, or roll feeds. Among the type of parts that can be made on a rotary swager are: axle housings, gear shift levers, tubes, and nozzles.

Spline Rolling

A method of producing toothed parts by roll forming has recently been developed. This is not merely a knurling process, because the exact number of teeth required are obtained each time. It is a cold working process in which a metal shaft is placed between forming racks. It emerges in a few seconds with the teeth completely formed at a predetermined position lengthwise on the shaft.

After the machine has been set up, tens of thousands of parts may be made without further adjustment. The machine may be operated manually, or it can be adapted to automatic loading. The

Chipless Production Panel

Letting the chips fall where they did the most good was this group of experts:

Panel Leader

R. L. Kessler,
Delco-Remy Division, GMC

Panel Secretary

W. P. Bowman,
Delco-Remy Division, GMC

Panel Members

R. G. Freidman,
National Machinery Co.

E. Abbey,
Etna Machine Co.

A. J. Langhammer,
Amplex Division, Chrysler Corp.

F. F. Badger,
Haynes Stellite Co.

W. McCardell,
Michigan Tool Co.

C. A. Nichols,
Delco-Remy Division, GMC

forming racks are made of high carbon, high chrome, and other alloy steels. The tops of the teeth on the leading end of the racks for a predetermined distance are step ground, similar to broaches, and gradually displace metal as they traverse the part.

Since no metal is removed, a diameter must be found on the spline where the area of the space below it equals the area of the tooth above it. This diameter is called the rolling pitch diameter, and is also the blank diameter before forming the teeth.

This process can be applied to many-shaped parts. It is possible to roll a spline or serrations adjacent to a shoulder without cutaway or damage to the shoulder. Axle shafts, drive shafts, torsion bars, transmission sliding parts, cranking motor shafts, and tapered serrations for steering shafts can be produced by this process.

Advantages of spline rolling are:

1—Parts can be produced up to 30 times faster than conventional machining methods.
2—Equipment costs less.
3—Less floor space is required due to the size of the machine itself, and fewer machines are required.
4—Tools cost less.
5—Parts can be made stronger with better finish.
6—Increased latitude for the engineer regarding the proximity of splines to shoulders.
7—Down time is reduced.
8—There are no chip removal problems.

Powder Metallurgy

The powder metallurgy method of manufacture has several unique characteristics which are not duplicated by any other method. Many self-lubricating porous bearings will work successfully only if they are powder metal bearings.

Other advantages of the powder metal manufacturing technique are:

1—Tool costs are usually low when compared with standard tool costs for making a part.

2—Most parts require only a short time for tooling-up and placing into production.

3—The powder metallurgy technique conserves engineering time, machine time, and productive labor.

4—Parts made from powder metals require very little machining to finish.

5—Powder metallurgy allows the product engineer more freedom of design.

6—Material required to make a part is kept to a bare minimum.

Within the last few years almost every type of steel alloy has become available in powder form. Practically all the usable nonferrous metals are now obtainable. Also, advances in powder metallurgy technique permit parts to be made up to 22 in. in diameter.

When a very close tolerance is desired on a powder metal part, an additional coining or sizing operation may be used after the sintering process. This will reseat any dimension that has gone out of tolerance.

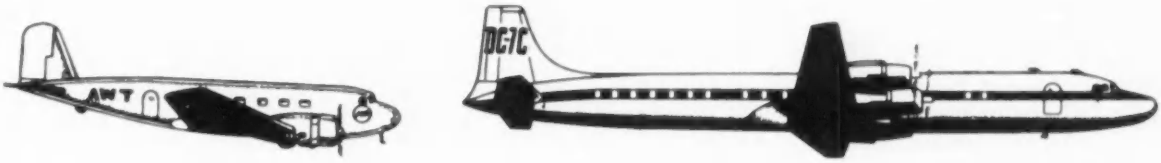
Investment Casting

Investment casting is used to cast almost any metal or alloy in simple or intricate shapes. This process is also called the lost wax method of casting. To make a part, a wax or plastic pattern of the piece is cast and then placed in a mold box. Molding material is then poured around the pattern and packed. When the molten metal that is to form the part is poured into the mold, the wax or plastic melts and is replaced by the molten metal.

By this method, hard-to-machine metals may be cast into almost the exact shape desired. Probably the greatest use made thus far of investment castings has been in manufacturing jet engine blades. The alloys used for jet blades are very hard to machine so the investment casting process has been ideal for producing the finished shapes. Investment casting complete blades costs approximately one-third less than forging them.

At the present time the thinnest section that can be cast is 0.012 in. Tolerances of ± 0.005 in. per in. can be held on a commercial basis. In the future many applications of the investment casting technique will be found. One item for consideration is the turbine and shaft assembly that will be needed in the turbine auto engines of the future.

(The report on which this article is based is available in full in multilith form together with reports of eight other panel sessions of the SAE Golden Anniversary Production Meeting, held in Cincinnati, March 14, 1955. This publication, SP-310 is available from the SAE Special Publications Department. Price: $1.50 to members, $3.00 to nonmembers.)



From DC-1 to DC-7 Symbolizes The Growth of Air Transport

A. E. Raymond, Douglas Aircraft Co., Inc.

Based on paper "DC-1, 2, 3, 4, 5, 6, 7 . . . n" presented at SAE Golden Anniversary Aeronautic Meeting, New York, April 19, 1955

DEVELOPMENT of the DC-1, progenitor of all DC series Douglas transports, was sparked by a letter of inquiry from Transcontinental & Western Air, Inc., which was seeking a new type of airline transport.

Accompanying specifications as to what would be needed to meet competition in transcontinental air travel, covered but a single sheet (Fig. 1). As completed, the DC-1 weighed 17,500 lb and was powered by two Wright R1820-F engines. Following its initial flight on July 1, 1933, it was performance tested for five months, during which it performed the spectacular (for that time) feat of taking off from Winslow, Ariz., and proceeding to Albuquerque, N.M., on one engine. Within two years it had established 19 world and U.S. records for speed and payload-range carrying.

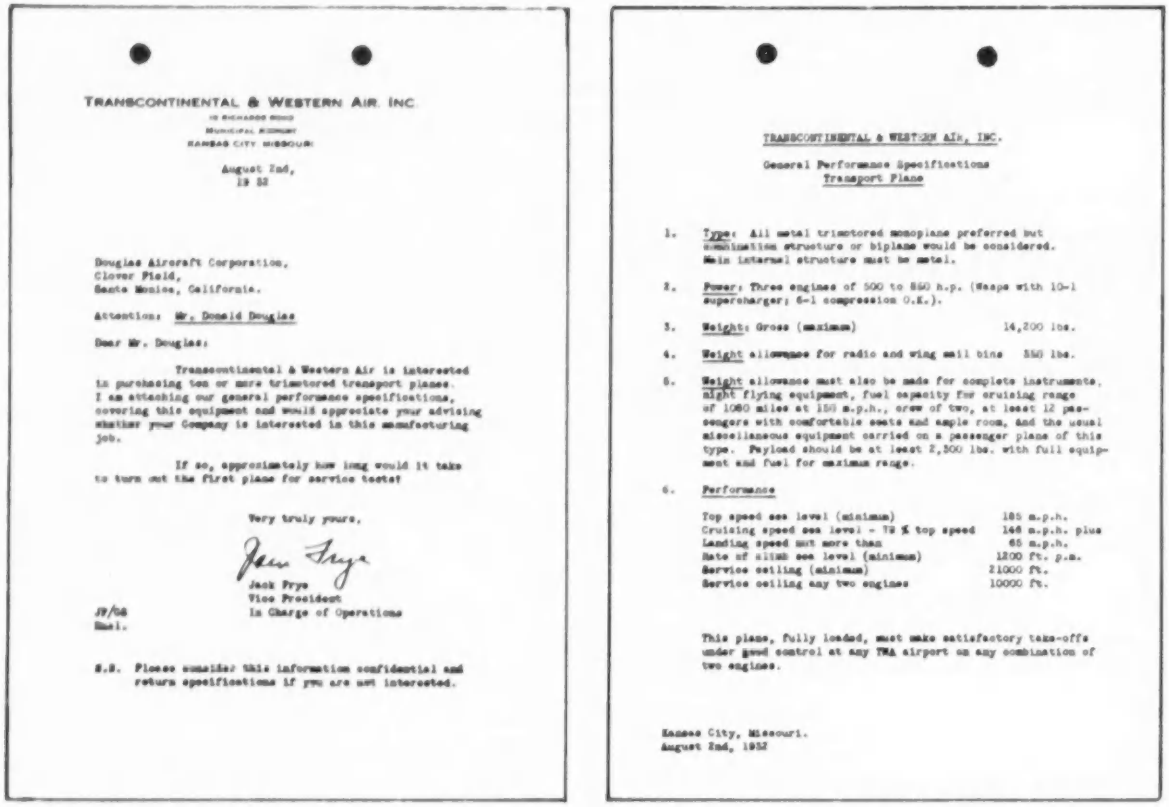
A revised model of the DC-1 came into being in 1934. It was powered by Wright 1820-F engines of 710 hp which increased its load-lifting ability to a point where 14 rather than 12 passengers could be carried. This was the DC-2, which won the transport class and placed second in the London-Melbourne Air Race of 1934. From an initial order of 26, production rose to 138 by 1938, and of this total 14 are reported to be still in existence in various parts of the world.

The DC-3 which took to the air in 1935 was developed to meet the need for greater capacity. It boasted a larger fuselage, greater wing span and area, and the more powerful Wright R1820-G2 engines. Its weight of 24,000 lb was later raised to 25,200 lb and it could carry as many as 24 passengers. Before production of this model and its variations ceased, 803 commercial models and 10,123 military versions had been built. As of about a year ago, 1541 were still in airline service and 210 were being operated by business and industry.

An attempt to build a four-engined liner, which would have twice the passenger-carrying capacity of the DC-3 and embody many new and untried features, was unsuccessful. When the resultant DC-4E underwent flight test it was found to be an inferior plane, having problems not to be solved promptly. After expending 500,000 engineering man hours and $3,000,000, the project was abandoned. Then came the DC-5 in 1938.

Foreign airlines were interested in a high-wing airplane, so the DC-5 was planned as that type of transport in the weight class of the DC-2. By the time it made its initial flight in 1939, gross weight had increased to 20,000 lb. This made it too competitive with the DC-3 to be popular, and what with military orders for other models tying up production, only 11 were built—five commercial and six military versions.

Profiting from experience with the stillborn DC-4E, the DC-4 matured and was being built for several airlines when World War II broke out. Production was then diverted to the military. The first 12 to come off the production line had the configurations planned for commercial operation. Then pro-



TRANSCONTINENTAL & WESTERN AIR, INC.

KANSAS CITY, MISSOURI

August 2nd,
19 52

Douglas Aircraft Corporation,
Clover Field,
Santa Monica, California.

Attention: Mr. Donald Douglas

Dear Mr. Douglas:

Transcontinental & Western Air is interested in purchasing ten or more trimotored transport planes. I am attaching our general performance specifications, covering this equipment and would appreciate your advising whether your Company is interested in this manufacturing job.

If so, approximately how long would it take to turn out the first plane for service tests?

Very truly yours,

Jack Frye
Vice President
In Charge of Operations

JF/bb
Encl.

P.S. Please consider this information confidential and return specifications if you are not interested.

TRANSCONTINENTAL & WESTERN AIR, INC.

General Performance Specifications
Transport Plane

1. Type: All metal trimotored monoplane preferred but combination structure or biplane would be considered. Main internal structure must be metal.

2. Power: Three engines of 500 to 800 h.p. (Wasps with 10-1 supercharger; 6-1 compression O.K.).

3. Weight: Gross (maximum) 14,200 lbs.

4. Weight allowance for radio and wing mail bins 550 lbs.

5. Weight allowance must also be made for complete instruments, night flying equipment, fuel capacity for cruising range of 1080 miles at 150 m.p.h., crew of two, at least 12 passengers with comfortable seats and ample room, and the usual miscellaneous equipment carried on a passenger plane of this type. Payload should be at least 2,500 lbs. with full equipment and fuel for maximum range.

6. Performance

Top speed sea level (minimum)	185 m.p.h.
Cruising speed sea level - 75 % top speed	148 m.p.h. plus
Landing speed not more than	65 m.p.h.
Rate of climb sea level (minimum)	1200 ft. p.m.
Service ceiling (minimum)	21000 ft.
Service ceiling any two engines	10000 ft.

This plane, fully loaded, must make satisfactory take-offs under good control at any TWA airport on any combination of two engines.

Kansas City, Missouri.
August 2nd, 1932

Fig. 1—This communication from Transcontinental & Western Air, Inc. spurred the DC-1 and launched the DC Series of Douglas transports.

duction was switched to a cargo version. The first DC-4/C-54 flew in March 1942 and before V-J day 1089 had been built. After V-J day 74 commercial-version planes were produced. A recent check revealed 366 DC-4's to be now in commercial operation.

Success with the DC-4 spurred development of a post-war transport incorporating more powerful engines, a pressurized cabin, increased passenger capacity, greater speed, and more luxury. The culmination of this effort was the DC-6 which first flew in 1946 and of which 174 have been built to date.

The DC-6 launched a series within a series. The DC-6A and 6B which followed had a 60-in. fuselage extension and more gross weight. The DC-6A, of which 39 have been built or are on order (exclusive of military versions), was an air-freighter; the DC-6B, with more passenger and cargo carrying capacity than the DC-6, has been produced or ordered to the number of 229.

Table 1—The DC-7 Contrasts with Its Ancestor the DC-4 of 1942

	DC-4	DC-7
Gross weight	50,000 lb	126,000 lb
Power (take-off)	1450 hp	3250 hp
Fuselage length	93 ft 5 in.	108 ft 11 in.
Payload		
Passengers	42 adults	58 (88 hi-density) adults
Cargo	5138 lb	15,880 lb

Although the DC-7 resembles the DC-6 at first glance, it has a number of developments designed to give greater speed, higher economy, more safety and comfort. Its Wright R-3350 Turbo-Compound engines developing 3250 bhp for take-off, permit a maximum take-off weight of 122,200 lb and a maximum range of 4600 miles. In contrast to the 315 mph cruising speed of the DC-6, the DC-7 is 360 mph.

To enhance safety, titanium has been used extensively in the nacelle structure, and a new design of main landing gear is employed. The latter can be used as a speed brake to decelerate rapidly when meeting heavy turbulence and to make steeper descents without exceeding normal speeds when arriving at the destination.

Comfort is enhanced by a supercharging system which permits a cabin altitude of 8000 ft at airplane altitude of 25,000 ft. In addition, a freon system cools the cabin to any desired temperature.

The domestic version of the DC-7 has a maximum fuel capacity of 5512 gal while that of the over-water version (DC-7B) is 6490 gal.

The DC-7 represents a continuing program of improvement from its forebear the DC-4 of 1942. Table 1 reflects the advances.

The maximum speed of the DC-7 is 176 mph

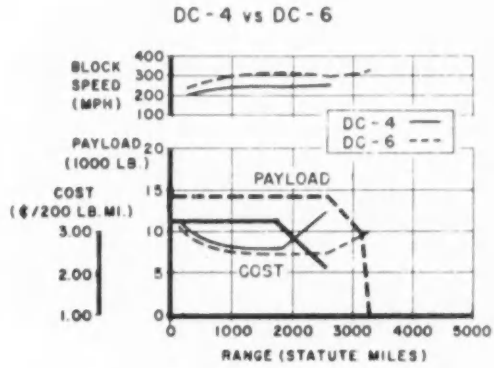
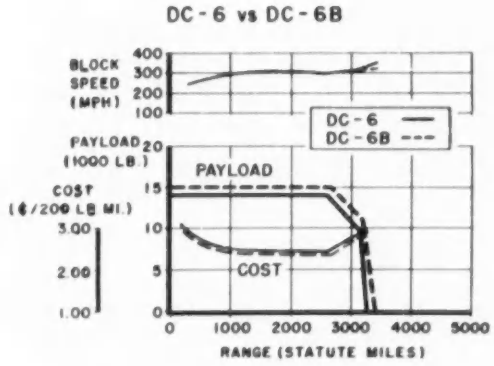
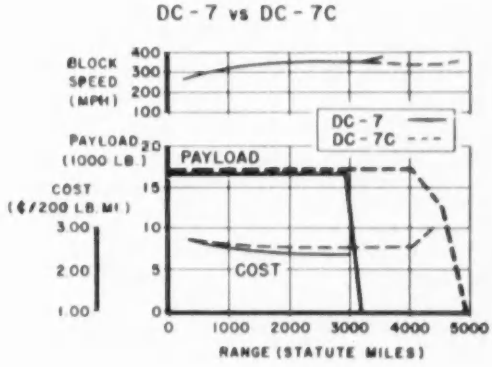
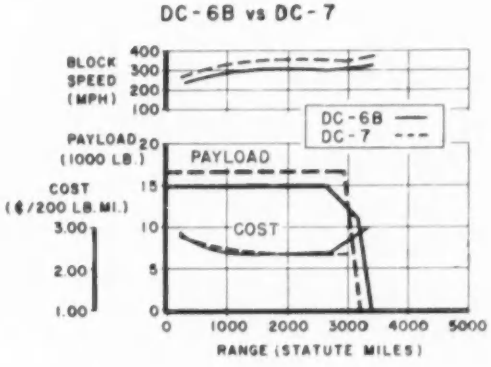
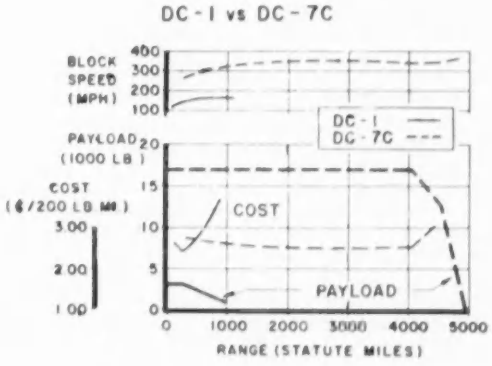


Fig. 2—These comparative operating data of DC series transports, showing improvement by model increments, portray the general advancement in air transportation.









greater than that of the DC-4. The cruising speed is 141 mph greater, an increase of more than 75%.

First flight of the DC-7 took place in May 1953 and to date 117 of them have been delivered or are on order, but that has not ended the series. The DC-7C, or "Seven Seas," so named to emphasize its intercontinental capabilities, has been announced. This model boasts five improvements over its predecessor:

1. There is a 10-ft addition to the span of the centerwing to increase fuel capacity to 7860 gal.
2. The added span moves the engines 5 ft outboard, thus reducing cabin noise and vibration.
3. Wright EA-1 engines increase available take-off power to 13,600 hp.
4. Fuselage length is increased 40 in. to give additional seating or cargo space.
5. The design provides for a maximum take-off gross weight of 139,000 lb and a landing weight of 107,000 lb.

The "Seven Seas" will carry 62 passengers plus cargo and mail to a total of 16,740 lb for almost 4500 miles with adequate reserves. Thus the DC-7C can span any continent or ocean of the globe non-stop. To date, 81 have been ordered for deliveries beginning June 1956.

Early records show the DC-2 able to operate an average of 6 hr per day in domestic airline use. Without the forced draft of war the DC-3 realized 10 hr. The DC-6 achieved a utilization of 6½ hr per day within nine months of initial delivery of 100 airplanes. One year later, with 150 planes in service, 9 hr per day had been reached. Several operators are now realizing utilization as high as 13 hr on some DC-6B service. Comparison between models of the DC series, as shown in Fig. 2, reveals the steady gain in economic advantage to airline operators. (Paper on which this abridgment is based is available in full in multilith form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

Based on Discussion . . .

William Moss, Pan American World Airways, Inc.

Douglas transports have been lengthened progressively in multiples of 40 in. What is the magic in this number?

A. E. Raymond

Forty inches is the space required for an additional row of standard low-density seats and is twice the distance between frames. One addition included an extra 20 in. which was required for other items of equipment.

Wing Commander A. J. Mackie, Royal Canadian Air Force

What are manufacturers doing about the increasing complexity of aircraft?

A. E. Raymond

Lip service has been given to simplification and standardization but little has been accomplished. Customers' special requirements usually result in further complications. Jet and turboprop engines are bringing simplified cockpits. Further simplification will be forced by such airplanes as the Boeing 707 and Douglas DC-8 due to their cost and the fewer number needed to absorb available traffic. The smaller number will result in higher unit prices unless there is more standardization and simplification.

J. T. Dyment, Trans-Canada Air Lines

As customers, we are more responsible for lack of simplification. Once something is installed we are reluctant to drop it out even if the manufacturer might like to see us do so.

H. R. Harris

You have said that Douglas would build a jet provided you received enough commercial backing. How much backing would you require?

A. E. Raymond

Enough to make it a reasonable business venture.

R. D. Kelly, United Air Lines, Inc.

How can we afford the jet, particularly if the initial order is just the start of another series of models such as experienced with today's transports?

A. E. Raymond

With the jet another set of conditions exists to inhibit new models. Costs are greater, so new models can be expected less frequently.

H. L. Hibbard, Lockheed Aircraft Corp.

Since the speed of proposed jets is approaching the sonic barrier, changes will probably be aimed at improving weight and capacity. Jumping the sonic barrier will be the next really big step. Speed can then be increased, but that is a long way off.

More Plastics For Truck Bodies

EXPERIENCE with plastics during the past few years indicates that more and more truck bodies may be made of reinforced plastics once the many problems involved have been solved. Among the advantages claimed for using plastics for truck bodies are:

1. High strength-weight ratio.

2. High impact strength and ability to take punishment and return to original condition without permanent damage.

3. Ease of maintenance, repair, and cleaning.

4. Resistance to chemical or electrolytic attack, or deterioration.

5. Good thermal and electrical insulation.

6. Ease of bonding.

7. Adaptability to mass production techniques.

Disadvantages reported by various plastic users include:

1. High cost of raw materials.

2. Low modulus of elasticity.

3. Low endurance limit.

4. Fractures from internal abrading of the glass fiber reinforcement.

5. Weakening and failure of structures because of poor adhesion between the plastic and its glass fiber reinforcement.

6. Inadequate and faulty engineering knowledge of the subject.

The plastics and transportation industries are working hard to solve these problems. At the SAE Golden Anniversary Annual Meeting in Detroit, representatives of both industries met in a Symposium entitled **Plastics For Truck Bodies.** Here is what they discussed:

THIS ARTICLE is based on the five papers and discussion presented at the **Symposium-Plastics For Truck Bodies,** which was held during the SAE Golden Anniversary Annual Meeting, Detroit, Jan. 13, 1955, and two papers on the same subject presented at the SAE Golden Anniversary West Coast Meeting, Portland, Ore., Aug. 17, 1955. The Symposium will appear in full in 1956 SAE Transactions. Complete copies of all five symposium papers and discussion are available from Special Publications Department. Price: $1.50 to members, $2.75 to nonmembers. The following individual papers, which were presented at the West Coast Meeting, are also available at 35¢ each to members, 60¢ each to nonmembers:

Plastic Bodies Can Be Repaired
Henry Jennings, Fleet Owner Magazine

The Development of Reinforced Plastics in Commercial Vehicles
S. S. Wulc, Consultant

Plastics for Truck Bodies

Hiram McCann, Modern Plastics Magazine

THERE are two main types of plastics: thermoplastics and thermoset materials. Thermoplastics, like a candle, can be melted by heat and rehardened by removing heat. Thermoset materials, like a hard-boiled egg, cannot be melted once they have been fused or cured. Usually, thermoset materials resist heat better than thermoplastics.

Thermoset materials such as polyesters and epoxies have caught the imagination of truck designers because:

1. These resins are very compatible with fibrous

glass reinforcement—the strongest reinforcement one can use.

2. They may be catalyzed to produce a cure, thereby obviating the use of outside heat in making moldings.

3. Since they may be cured this way, they can be molded with reinforcement at very low pressures and, in many cases, on low cost tubes.

Unfortunately, even with these and many other advantages, there are several negative factors which have slowed down their being adopted for mass produced automobile bodies.

Making a reinforced plastic truck body is a very complicated process involving "on the spot" combining of liquid resin, glass fiber, inert filler, catalysts, reaction inhibitors, and coloring pigment. Each design variation affects both chemical and mechanical engineering. So far, we lack both definitions and standards of materials and methods.

Fortunately the Reinforced Plastics Division of the Society of the Plastics Industry has already begun to bring the plastics and automotive industry together to produce useable engineering data and standards. Resin makers are trying to simplify and standardize the many specialized materials now available. As more technical information is collected and as molding facilities are expanded, engineering efficiency will be improved considerably.

Plastics for Pick-up Trucks

W. R. Herfurth, United Parcel Service

MANY long range and short range economies can be realized by using pick-up truck bodies made of fibrous glass reinforced plastic.

Eventually initial costs will be less. Even though raw materials are higher, in the future the total labor cost of fabrication, assembly, and mounting about 20 moldings per body, plus amortization of design and tooling costs over a limited production, will be less than the same costs of making several hundred individual parts for a metal body.

The strength-weight ratio of properly made glass fiber laminates results in less total weight even though sections may have to be thicker. Although the United Parcel Service does not have to conform to gross vehicle weight limitations, this weight savings helps reduce fuel consumption and tire wear. Also, the riding quality and roadability of the truck is improved due to the lowering of the center of gravity. It is conceivable that for a given size body and payload a lighter weight chassis could be used.

Fender and body damage is reduced due to the flexibility and energy absorbing ability of glass fiber laminates. As far as we know, the life of the body is limitless. We will not have to be concerned with corrosion, electrolysis, dry rot or decay as we must with aluminum, steel, or composite bodies. Too, the body does not require undercoating.

Cleaner vehicles and less washing expense result since we can use washing solutions with greater detergency without fear of damaging the surfaces.

Since the plastic body is a good insulator, the drivers are protected from the heat on hot summer days. Less heat fatigue should result in more efficient work.

The translucency of the unpigmented laminate permits us to provide a skylight in the compartment roof. There are no joints which could leak or glass which could break. Since body lights will not be used as much, there will be less drain on the battery.

Plastics for Transport Tanks

D. S. Brown, Bendix Corp

GLASS fiber reinforced plastics are admirable materials for liquid transportation tanks. However more extensive use has been held back because some manufacturers attempted to use designs originated for steel. They merely substituted laminated plastic for the metal. This inadequate and faulty engineering often resulted in:

1. Weeping or permeability of the tank.
2. Fractures due to internal abrading of the glass fiber reinforcement.
3. Weakening and failure due to poor adhesion between the glass fiber reinforcement and the plastic itself.

The use of a new material requires revaluating present designs and devising new ones more suitable to reinforced plastics.

There are three methods of making reinforced plastic tanks:

1. Hand lay-up with mat or glass cloth.
2. Matched die formation of sections later assembled.
3. Dry lay-up forming entire tank units.

Although most transport tanks now in use were made by hand lay-up, this method is costly and it doesn't utilize the full strength of the materials.

The second method produces a tank with better chemical and moisture resistance, higher strength and lower weight. Costs are high because a great deal of hand labor is needed to assemble the sections into a finished product. This method is best for small tanks where assembly can be kept to a minimum.

In the dry lay-up method the entire tank assembly, including valve fittings, manhole fittings, fittings, for attachment to running gear, brakes, and lights, are laid up into the mold. Then the resins are introduced and the pressure applied. After a short cure period the entire unit is taken from the mold and running gear, valves and lights are attached. The dry lay-up method gives a more uniform structure and quality can be controlled better than with the other methods.

At present, glass fiber reinforced polyester resins are most widely used. In the future, silicones and

epoxies and perhaps alloys of either with new rubber compounds will be used more and more. Thus tanks with high strength, low weight, and chemical and flame resistance will be available.

Inner liners are used to prevent contamination of liquids. One manufacturer offers a light gage stainless steel liner for the necessary liquid opacity and corrosion resistance and sanitary surface. The tank can be used interchangeably for any chemicals. This same design has a sandwich wall for insulation. This sandwich construction—made of glass fiber, reinforced plastic outer surfaces and low density, expanded plastic cellular core—will be the best low weight, high strength, high capacity, general purpose tank available.

Plastics for Trailer Bodies

S. S. Wulc, Consultant

THE automotive industry is using reinforced plastics more and more. In trailers, the gradual introduction of plastic components such as doors and liners for refrigerated vans, skylights, and plastic side panels have finally culminated in a virtually all-plastic refrigerated vehicle.

Wooden insulated doors often could not give an effective air seal because they would warp and swell when wet. Also they were heavy, and difficult to clean. Metal doors were poor insulators, they corroded easily, and if made out of thin sheets (to save weight) they damaged easily.

Polyester glass reinforced laminated doors did away with these problems.

Similar problems were solved by using plastic linings in our refrigerated trailers. Designed with corrugation to allow space between the cargo and the inner surface, plastic linings allow air to circulate better, thereby maintaining uniform temperatures. They are stronger and lighter than metal or wooden liners, and are excellent insulators. Since they have no open joints and no plywood interlining which can rot and harbor maggots, plastic liners are more sanitary. Too, they can be steamed out without harm and can be repaired in case of damage.

The all-plastic refrigerated trailer was a logical outgrowth of the success of the plastic-lined refrigerator trailer. Its structural members are made of reinforced plastic instead of wood or aluminum. Each member serves also as a spacer between the inner corrugated plastic and the outer smooth skins. The space between them is filled with insulation. The sub-frame of plastic cross members and insulation is sandwiched between the aluminum extruded floor and plastic sheets.

Chief advantages of the plastic refrigerated trailer are:

1. Saves about 20% weight.
2. Increases cubic capacity.
3. Decreases maintenance and increases durability.
4. Increases insulation qualities.

The development of the vehicle was made possible by a very special glass reinforced laminate called "Lamicor." A ¼-in. thick sheet of Lamicor has tensile strength of about 27,700 psi, a modulus of elasticity in tension of 1.87×10^6 psi, and impact strength of 16.99 ft-lb per in. of notch. Flexural strength is about 37,000 psi, double shear strength about 8200 psi, and edge compressive strength about 35,200 psi.

Plastic Bodies Can Be Repaired

Henry Jennings, Fleet Owner Magazine

FIBROUS glass reinforced plastic is easy to repair Personnel need very little training and experience before they become very proficient. The following pictures illustrate the successive steps in repairing a 4½ × 1½ in. hole in a plastic body panel.

(CONTINUED ON NEXT PAGE)

1

AREA AROUND THE HOLE is cleaned with a standard shop solvent, then sanded about 6 in. on all sides. The sanding should be deepened at the hole to a give a V or scarving effect.

Plastic Bodies Can Be Repaired

(continued)

2

GLASS FIBER CLOTH patches are cut with ordinary shears or a shoeknife. The first patch must overlap the break about 2 in. in all directions. Other patches should be cut in graduated sizes to fill out the sanded area — one patch for each 0.025 in. panel thickness.

PATCHES ARE WEIGHED to determine the amount of resin needed. About 2/3 more resin than cloth by weight is needed. Roughly the mixture is 100 parts resin, to 50 parts pigment, to 3 parts catalyst, to 3 parts promoter.

3

4

FIRST PATCH is painted with resin. Then other patches are applied and painted similarly.

CELLOPHANE SHEET is laid over the area with an ordinary scraper. The area is smoothed out by working from the center to the outer edges.

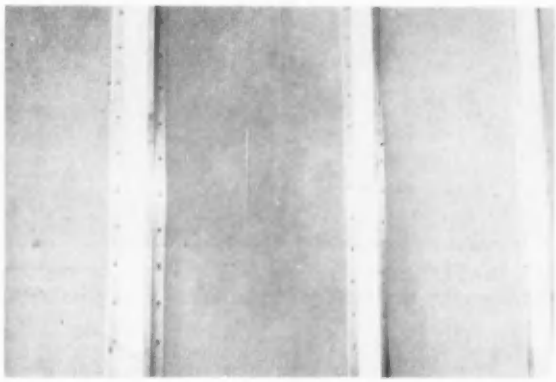
5

PRESSURE PLATE is applied with very gentle pressure for about 1 hr.

6

7

AFTER PLATE and cellophane are removed, the area is sanded again.



REPAIRED PANEL looks as good as new. It is recommended that when possible a fracture should be repaired on both sides.

Discussion

W. G. Schultz, Ford Motor Co.

HENRY Ford engineered a plastic car development almost 20 years ago. Since then much progress has been made using plastics instead of more conventional materials. We would like to use more plastics, but they must give us better performance, better economy, and better appearance.

Glass fiber reinforced plastics are particularly good for special purpose vehicle bodies of relatively low volume manufacture. For large volume production there is still much to be done to cut down man hours and improve engineering design. At present the average plastic body cannot compete with a well-engineered and economically produced steel or aluminum body. By integration—combining many pieces into one plastic molding—and using plastic foam stabilizers of the cellular type, reinforced glass fiber plastics can gain considerably.

In the future, radiation from an atomic pile may be put to use converting thermoplastics into thermoset materials. Strong plastic laminates from Furane resins will produce low pressure panels with flexural strength of 65,000 psi, and edge compressive strength up to 40,000 psi. This resin can be made from noncritical materials like corn cobs and other vegetable by-products. A glass-filled silicone recently developed, will take high bake enamels up to 450 F. Other techniques, such as integrating many parts into one by die-casting, pre-mixing compounds and orienting fibers in one direction to simulate grain, postforming, and new ways of reinforcing secondary bonds, will also play important rolls in the future of plastics for truck bodies.

A. J. Carter, Chrysler Corp.

IN 1944 we started an intensive program to evaluate the physical and chemical properties of reinforced polyester plastics. We made the following parts from plastic:

Chrysler rear deck lid
Chrysler station wagon door
Plymouth right rear fender
Plymouth turret top
DeSoto rear deck lid
DeSoto hood
DeSoto rear fenders
DeSoto instrument panel

The average weight savings in these parts was 48%. All parts performed successfully on road test cars.

Since this program Chrysler has continued to investigate plastics for automobiles. In the 1955 models, the heater housing assembly is all plastic.

We and other companies must continue pioneering in the use of plastics so that we can get better insight into the type and amount of equipment necessary to meet production line requirements. We must find out what fabricating and assembling techniques

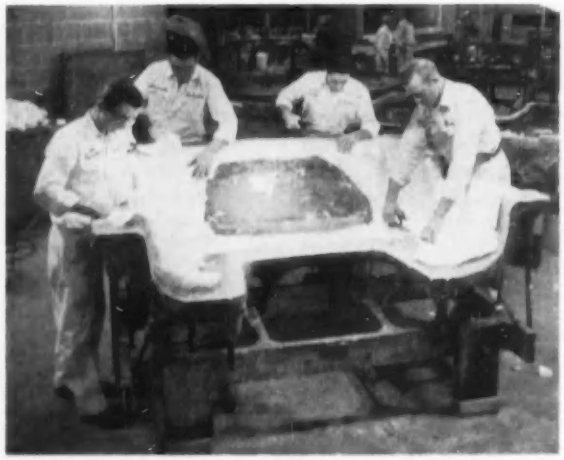
8

ALL-PLASTIC pick up truck has a rear door of glass fiber reinforced plastic which slides on tracks inside the roof.

9

10

TRANSLUCENT roof section of all-plastic truck body permits diffused light to illuminate the interior.



HAND LAY PROCESS was used at first to obtain limited production of the Corvette body quickly regardless of the high piece cost. A sandwich of woven fiber glass cloth filled with mat provided the reinforcement.

are most practical for making a plastic body, the type of cemented and mechanical joints necessary, and the amount of sanding and reworking of the plastic surfaces to get good paint jobs.

E. J. Premo, Chevrolet Motor Division, GMC

AT first the plastic-bodied Corvette was produced by the hand lay-up method. This gave us fast production but at high unit cost. Then the vacuum bag process was used until the matched metal die process could be perfected and installed. The latter method resulted in the highest unit cost.

The matched metal die process used preforms of glass fiber roving which were cut in short lengths and deposited on a screen shaped to the inside contour of the finished part. Fibers are kept on the rotated screen by suction and a small amount of resin is sprayed on to hold the resulting preform together. The preform and screen are then passed through an oven to cure the resin binder. To obtain a smooth surface suitable for exterior panels, very fine filaments of fiber glass are deposited on the outer surface of the preform, or a fine textured surface mat is layed in the metal die. Then the preform is added and a measured amount of resin poured in. The die is closed for a curing cycle of 2 to 3 min, after which it automatically opens. This process yields from 15 to 25 parts per hr.

R. S. Ames, Goodyear Aircraft Corp.

ALTHOUGH plastic materials are more expensive than metals, tooling costs are usually less. Therefore there is a break-even point. Particularly if the plastic part is well-designed and integrates a large number of parts, then the number of parts and tools are reduced. This increases the quantity of plastic parts which are equal in cost to a metal assembly.

ALL-PLASTIC sports car was made finally by matched metal die process using preforms made of fiber glass roving.

11

12

Beware of Rust You Can't See

non-protective rust formed in sheltered regions accelerates corrosion failure of auto bodies.

J. C. Holzwarth, R. F. Thomsen, and A. L. Boegehold,

Research Laboratories Division, GMC

Based on paper "A Study of Non-Protective Rust Formation on Auto Body Sheet Steel" presented at the SAE Golden Anniversary Summer Meeting, Atlantic City, June 14, 1955

RECENT tests developed at the GM Research Laboratories for the evaluation of auto-body steel reveal that there are two kinds of rust, non-protective and protective. The tests show that:

1. Corrosion failure of auto bodies generally results from non-protective rust formed in sheltered areas of the auto body. This rust is composed predominantly of magnetite, Fe_3O_4, with a small amount of iron oxide hydrates, $Fe_2O_3 \cdot H_2O$.

2. For steel compositions tested, protective rust formed on low-alloy steels exposed on outdoor test racks is essentially all iron oxide hydrate. Under sheltered conditions, rust formed outdoors with these same steels may be non-protective, occurring as porous rust with high percentages of magnetite and small percentages of iron oxide hydrates.

3. Non-proteetive rusts formed in the GM Research corrosion test and those associated with auto-body service failure have the same physical characteristics and composition. Both ordinary rimmed

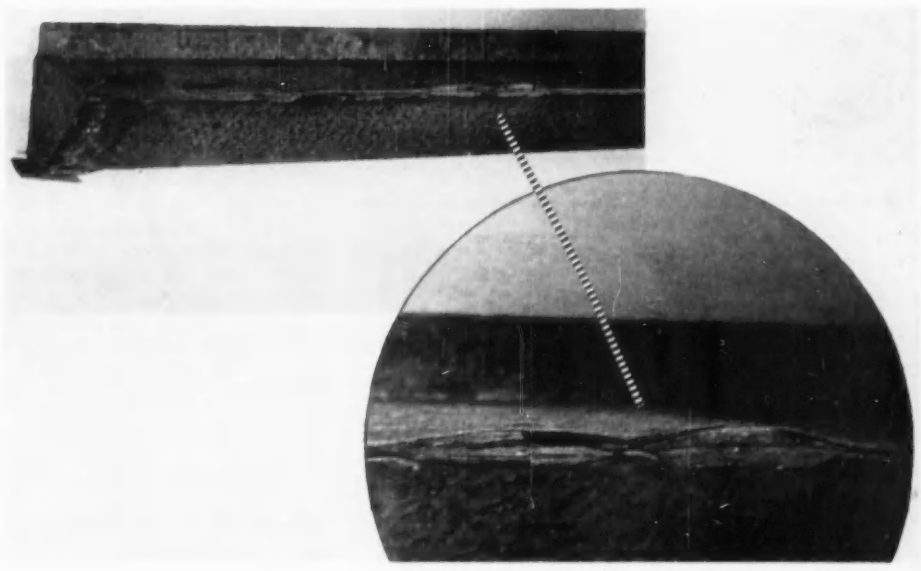


Fig. 1—Both protective and non-protective rusting occur here on a part made of rimmed auto-body steel. The heavy rust (inset) is typical of non-protective rust found in auto-body crevices or sheltered areas.

body steels and some low-alloy steels form non-protective rusts when subjected to the GM test.

4. Alloying elements aiding protective rust formation in outdoor tests do not necessarily contribute to protective rust formation under sheltered corrosion conditions in the GM test. Some elements like carbon, however, which have little effect on the corrosion resistance of steels in outdoor tests, appear to reduce corrosion under the sheltered conditions of this test.

To combat non-protective rust formation in particular, the auto industry must develop better steels or new ideas for improved design and protective coatings.

Table 1—X-Ray Analysis of Rust Associated With Auto-Body Service Failure

Rust Location	Model	Manufacturer[a]	Composition	
			% Fe_2O_3	% $\alpha Fe_2O_3 \cdot H_2O$
Rocker Panel	1939	L	80	20
Fender Welt	1941	M	85	15
Inner Door	1942	L	80	20
Fender Welt	1942	N	85	15
Window Well	1942	L	85	15
Fender Welt	1946	M	90	10
Rocker Panel	1946	M	85	15

[a] L, M and N represent the three largest manufacturers of auto-bodies.

Table 2—X-Ray Analysis of Rust Formed on Outdoor Test-Rack Samples Exposed at Kure Beach, N. C.

Steel	% Fe_2O_3	% $\alpha Fe_2O_3 \cdot H_2O$	% $\gamma Fe_2O_3 \cdot H_2O$
A Rimmed Body Sheet[a]	None	50	50
A' Crevice-Rimmed[a]	85	15	None
V Open Hearth Steel	None	50	50
W High-Strength, Low-Alloy	None	40	60
X 2115	None	50	50
Y SAE 2515	None	60	40
Z 3% Cr Steel	None	50	50

[a] Sample A rust was removed from the openly exposed surface of the rocker panel shown in Fig. 1, while sample A' was removed from the crevice of this same rocker panel.

Table 3—X-Ray Analysis of Rust Produced in 20-Day GM Research Test

Steel	% Fe_2O_3	% $\alpha Fe_2O_3 \cdot H_2O$	% $\gamma Fe_2O_3 \cdot H_2O$
Rimmed Auto Body	85	15	—
High-Strength, Low-Alloy	90	10	—
Open Hearth Iron	85	15	—
Open Hearth Steel	85	15	—
High-Strength, Low-Alloy	80	15	5
2115	90	10	—
SAE 2515	85	15	—
3% Cr	85	15	—
Carburized Rimmed	40	30	30

Types of Body Rust

Auto-body corrosion is generally characterized by two types of rust that occur (1) on the exterior surfaces, and (2) in sheltered areas or in crevices. The first type is readily seen and is controllable by touch-up and periodic maintenance. The second type is more troublesome, for it is hardly ever observed until irreparable damage is done, and is greatly accelerated due to the non-protective character of the rust.

Sheltered Corrosion

Complete and rapid drying are essential to the formation of protective rusts. If soluble corrosion products are not washed away or the corroded areas do not dry completely, accelerated formation of high-porosity, non-protective rust will result. Obviously, then, sheltering accelerates corrosion by retarding protective rust formation (Fig. 1).

GM Research Corrosion Test

In the 20-day GM test, bare steel panels in a constant-temperature cabinet are corroded by the combined action of (1) exposure to air of cyclically varying humidity, and (2) wetting once daily with a dilute salt solution. The test was developed to provide fast means of obtaining non-protective rust of the type formed on sheltered areas in auto bodies. It is useful in rapid evaluation of the corrosion-resistant qualities of newly developed auto-body steels. Examination of rust taken from specimens so tested and from sheltered auto-body areas indicates that the non-protective rust formed in both cases is the same. It consists of alternate layers of magnetite and iron oxide hydrates, the former predominating. On the other hand, protective rust formed on openly exposed surfaces consists entirely of iron oxide hydrates with no magnetite.

Rust constituents were identified by microscopic examination and by X-ray diffraction techniques. Results are presented in Tables 1, 2, and 3.

Requirements of Improved Steel

Metallurgists recognize that there will always be some sheltered areas in the body. So they have aimed recent work at the root of the trouble. They seek to eliminate rust at the source—in the steel itself.

They hope to produce steel showing markedly improved resistance to sheltered corrosion of the order of two to four times that of present rimmed auto-body steel. (Improving steel recipes by the addition of large amounts of alloying elements is not the answer. Keep in mind cost and forming characteristics!)

The influence of alloying elements in steels is different under atmospheric tests and in the GM test simulating sheltered area corrosion. Present work is directed toward finding an additive or combination of alloying elements to produce increased resistance to sheltered corrosion at low cost and with no sacrifice in forming characteristics.

(Paper on which this abridgment is based is available in full in multilith form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

Use of statistical methods—like those used by insurance actuaries—to help designers predict risks and choose the smallest safety factor that will provide adequate protection equals . . .

Engineering Minus Guessing

Jerome Lederer,

Director of Flight Safety Foundation, Inc., and Consulting Aviation Safety Engineer

Based on paper "Actuarial Approaches To Safety" presented at SAE Golden Anniversary Aeronautic Meeting, New York, April 18, 1955.

BY ANALYZING statistics of past performances, mathematicians in the aircraft industry are starting to take more of the guessing out of engineering. Four ways in which statistical analysis has been applied to airplanes are:

1. Predicting likelihood of engine failures.
2. Predicting likelihood of accidents.
3. Predicting likelihood of fires after crashes.
4. Determining potential passenger overloading.

Predicting Engine Failure

Records of past engine performances are the starting point in predicting engine failure. The number per unit of flight time has been established for some flight stages. During the test of one engine, for example, a failure rate of 3.5 engine failures for every 10,000 flying hours was established.

A typical frequency distribution curve of climb performance of a four-engine plane is shown in Fig. 1. The relative sizes of the three humps indicate their relative probabilities. The curve for all engines operating is much larger than either of the other two curves. The probability that one engine will fail during any one flight is about 1300 in 1,000,000. The probability that two engines will fail is about one in 1,000,000. The probability that more than two engines will fail is so remote we can neglect it.

In Fig. 1, if we divide the shaded area to the left of AA by the total area under all three curves the probability of the performance dropping below AA may be obtained. This probability calculation is characteristic of all frequency distribution curves.

Predicting Accidents

Fatalities per hundred million passenger-miles, accidents per million miles, or accidents per thousand hours of flying time are commonly used to indicate airline safety. None of these yardsticks is completely satisfactory.

Consider one passenger flying nonstop for 1 hr at 300 mph in an airplane. Consider also one passenger flying the same hour at 80 mph in a helicopter making two stops. At the end of the hour the two aircraft collide and both passengers are killed.

For the airplane the safety record is one fatality

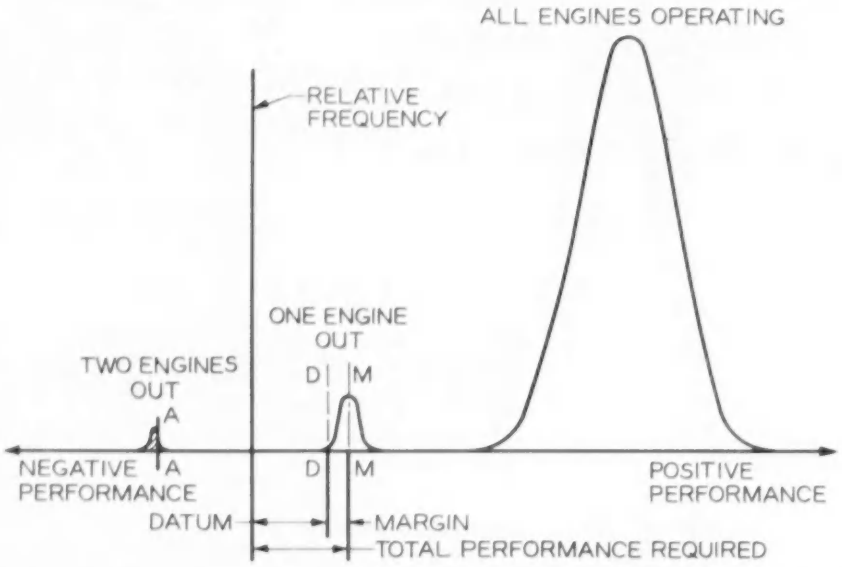


Fig. 1—Normal frequency distribution curve for engine failures.

for 300 passenger-miles. For the helicopter the record is one fatality for 80 miles. On the basis of passenger-hours the records are equal. On the basis of the number of flight stages the records are unequal since the helicopter landed twice.

Statisticians agree that numbers of passengers has no connection with safety records (in terms of crash rates). Measuring airline safety is not a simple task.

By combining passenger-miles, flying time, and number of flight stages, Shirley Kalleck of the Flight Safety Foundation has arrived at a formula which may predict accident rates:

$$A = K\left[\frac{N}{H} \times \frac{M}{O}\right]$$

where

A is the accident rate per hour the aircraft is exposed to an average stage length.

K is the index of accident exposure (constant).

$\frac{N}{H}$ is accidents per hour of flight time.

$\frac{M}{O}$ is the stage length. It is the average of miles flown per number of flight stages (operations).

The constant K can be calculated statistically. The overall accident probabilities per hour and per flight can be determined from past records. Next, the number of over-all flights should be classed according to the numbers of long hauls and short hauls, transoceanic and transcontinental, flights over flat terrain and mountainous terrain, and so on. Using the overall accident probabilities we may obtain a rate A for each class, which is based on accidents expected from chance. From our records we know $\frac{N}{H}$ and $\frac{M}{O}$. Dividing A by $\frac{N}{H} \times \frac{M}{O}$ gives us K for a class.

To date, K has not been evaluated. For $K = 1$, however, which corresponds to accidents expected from normal chance, results are shown in Table 1.

Predicting Fires After Crashes

From January, 1948, through June, 1951, 17,104 major airplane accidents occurred in the U. S. according to Civil Aeronautics Administration records. Of these accidents, 685 or 4% resulted in fires.

Wide differences occurred in the numbers of fires

Table 1—1952 Accident Rates Per 1000 Hr of Flight

Aircraft Type	Airline[a]	Accident Rate
A (DC-3)	A	1.749
	B	2.710
	C	4.114[b]
	D	2.059
	E	1.143
B	F	2.400
	G	15.633[b]
C	H	1.939
	I	1.605
D	J	18.326[b]
	K	10.716
	L	7.498
E	M	6.557
	N	41.890[b]
	O	2.959
F	P	8.595
	Q	9.668

[a] Each of these airlines operates several types of aircraft.
[b] Exposure less than 25,000 hr. A chi-square test applied to all airlines would determine which of these rates is due to chance alone.

for aircraft of different makes and models. In order to determine whether or not these differences were due to chance, the statisticians' "chi square" test of significance was applied to the CAA records.

The difference between the actual number of crash fires and the number that were normally expected was analyzed for significance. The actual number of crash fires was 685. The expected number of fires was determined by multiplying the total number of accidents for each model by 4%. (Remember that 4% of all accidents from January 1948 through June 1951 resulted in fires.)

Only aircraft which had 50 or more accidents for the 1948 to 1951 period were considered. Chi square was determined from the following formula:

$$X^2 = \Sigma \frac{(f_o - f_c)^2}{f_c}$$

where

X^2 = chi square
Σ = summation of
f_o = actual number of fires after crashes
f_c = expected number of fires after crashes

Chi square turned out to be 349.51 (Table 2). From "A Table of the Percentage Points of the Chi Square Distribution" by Hald and Sinkback, for 49 items (airplane models in this case) a chi square value of 84.04 corresponds to a normal chance occurrence of once out of a thousand. Since our test value of 349.51 is far greater than 84.04, the differences in the numbers of fires for different models of airplanes evidently are not due to chance.

Determining Potential Overloading

How much weight to allow for passengers must be considered when designing aircraft. A survey conducted in 1953 resulted in the recommendation that an average passenger weight of 160 lb be used for winter. This average weight was based on an average weight of 163 lb for men and 141.5 lb for women, and that on standard fare flights 75.5% are men and 24.5% are women.

But unless consideration is given to the variation of individual weights, an overload may very easily result on some flights. This overload potential can be calculated statistically.

Calculations show that, if actual passengers ran heavier than the average, on a 60-passenger airplane the overload could be 450 lb and on an 80-passenger plane 520 lb. Thus if 163 lb for men and 141.5 lb for women were used for design purposes, about six flights a day would leave Washington National Airport somewhere between 450 and 520 lb overloaded.

By applying statistical methods, it is possible to take into account variation of weight among individuals and the likelihood of various degrees of departure of the total passenger load from the average. Airplanes designed accordingly ought to be more profitable for their operators.

Statistical analysis of engineering data is now in a state of infancy. This new tool shows great promise, however, of eliminating much of the uncertainty in applying engineering calculations.

(Paper on which this abridgment is based is available in full in photo-offset form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

Table 2—Fires After Crash—Chi Square Analysis

Make and Model		Actual No. of Fires In Crash	Theoretical No. of Fires In Crash (4% of Crashes)	Value of Chi Square
A	1	0	2.97	2.97
	2	2	3.16	0.43
	3	40	66.00	10.24
	4	5	11.25	3.48
B	1	29	10.34	33.65
	2	8	3.08	7.84
C	1	1	3.04	1.37
	2	3	2.84	0.01
D	1	36	14.70	30.86
	2	4	3.73	0.02
	3	3	2.60	0.06
E	1	10	19.34	4.51
	2	18	41.93	13.66
	3	8	7.33	0.06
	4	3	2.88	0.00
	5	9	5.53	2.18
F	1	2	2.32	0.04
	2	10	8.45	0.28
	3	8	8.25	0.01
	4	15	7.37	7.90
	5	11	7.29	1.89
G	1	25	5.16	76.17
	2	16	5.73	18.43
H	1	2	3.45	0.61
I	1	22	29.60	1.95
J	1	4	11.58	4.96
	2	1	4.53	2.75
	3	3	3.40	0.05
K	1	0	3.32	3.32
	2	6	10.62	2.01
L	1	3	2.40	0.15
M	1	3	35.33	29.58
	2	0	11.41	11.41
N	1	11	2.97	21.76
O	1	6	9.13	1.07
P	1	23	20.43	0.32
	2	84	59.31	10.27
	3	2	2.16	0.01
	4	17	5.97	20.40
	5	2	2.00	0.00
	6	30	27.63	0.20
	7	18	11.10	4.29
	8	1	3.28	1.59
	9	5	5.85	0.12
	10	1	2.32	0.75
Q	1	1	4.49	2.71
R	1	1	3.69	1.96
S	1	7	22.99	11.12
	2	2	2.36	0.06
		Total Value of Chi Square		349.51

Four Alternatives to Longer

. . . all of which unfortunately cost money

G. W. Gilmer, Atlantic American Oil Co.

Based on secretary's report of the round table on "Ground Deceleration of Aircraft" at the SAE Golden Anniversary Aeronautic Meeting, New York, April 19, 1955

IN the development of modern aircraft, there must be taken into account the two mutually contradictory requirements of (1) higher flight and landing speeds and (2) the economic necessity for stopping aircraft within the boundaries of present or planned airports. Landing characteristics of present aircraft are such that the ratio of high speed to landing speed is of the order of 10. From an energy standpoint alone, it becomes obvious that conventional wheel brake systems employed in present transport aircraft are inadequate to cope with landings or aborted take-offs of newer aircraft.

Among the solutions to the problem, the first is to provide longer runways. This, however, is unjustified economically and not practical because of lack of sufficient land suitably located for building or expansion of airports. The cost of heavy-duty runway, complete including land acquisition, lighting, instrument-landing facilities, and so forth, is at least $1,000,000 per 1000 ft. Consider the fact that in 1948 the Civil Aeronautics Administration established a length of 8400 ft in its specification for an "international express runway" (CAA Technical Standard Order N6A), and that this figure is now considered marginal. The location and cost of airports with runways in the 10,000 ft class becomes quasi-prohibitive. This poses a real headache, and obviously, those agencies responsible for planning airport facilities are greatly concerned with progress made in the problem of ground deceleration of aircraft.

More reasonable alternate solutions to the problem of ground deceleration include:

1. Arresting gear and barriers.
2. Maximum utilization of standard wheel and brake combinations.
3. Skid-control accessories in conjunction with present braking systems.
4. Provision of reverse thrust for the aircraft.
5. Use of drag parachutes.

1. Arresting Gear and Barriers

Arresting gear is employed exclusively for all landings aboard aircraft carriers, and military experience indicates the feasibility of using barriers to stop fighter aircraft at landing speeds up to 180 mph. To anticipate routine barrier stoppage of conventional transport aircraft of the future is not practical from the point of view of aircraft and cargo damage and passenger discomfort. It appears that the use of barriers in conjunction with arresting hooks will be relegated to emergency use, and that other means will be employed for routine stoppages.

2. Wheel Brake System

The wheel brake system is a superb example of design limitations and requirements crowding the middle ground of the engineer's already over-taxed design ingenuity. Generally, the retarding force of the tire and brake combination depends on:

1. Ability of the brake to develop the necessary torque at the required time.
2. Weight on the braked wheels, which varies throughout the stop.
3. Coefficient of friction between tire and runway.
4. Pilot's ability to maintain brake application at the point of impending skid throughout the stopping cycle under conditions of constantly changing wheel loads.

Inasmuch as a given retarding force provides the maximum braking effort at the beginning, or high-speed, end of the stopping cycle, the object becomes to apply this maximum braking effort as soon as

Runways and weight

landing roll begins. To this end, reliable skid control devices have been developed to operate independently of the pilot, and have proved inexpensive, of low weight, and failsafe.

3. Reverse Thrust

Those who have flown in propeller-driven aircraft are familiar with reverse thrust obtained by reversing propeller-blade pitch. Reverse jet thrust is being evaluated for future use. For example, even though only about 50% of the forward thrust is reversed, normal landing-roll has been reduced 44 and 40% for the B-29 and F-84F, respectively. Disadvantages accruing from reverse jet thrust applications are being evaluated, and the prospects for success are favorable as design and development continue.

4. Drag Parachutes

In 1928, the Army Air Corps first tested drag parachutes. They were used frequently in emergency bomber landings during World War II, and have been provided as standard equipment on B-47's since 1948. Control of aircraft in runway crosswinds, short chute service life, installation and repacking, material, and operating temperatures surrounding the packed chute aggravate the problem in using drag parachutes. But the system *does* work and is successfully employed in current military aircraft.

Schemes such as boundary layer control and thrust conversion to provide vertical lift offer great promise for reduction of landing speeds.

ESTIMATED weight and cost of equipment required to achieve maximum deceleration of a four-engine jet bomber is:

Item	Weight, lb	Cost, $
Four wheels, brakes, and tires	2100	8000
Four wheel anti-skid control system	75	2400
Four reverse-thrust installations	600	60,000
One tail hook and reinforcing structure	150	1500
One drag parachute installation	150	1000
Totals	3075 lb	$72,900

Faced with no other currently available and practical solution to avoid continuous extension of runways, these serious weight and cost penalties must be absorbed.

THE following constituted the panel of this round table:

Chairman:

R. C. McGuire, Eastern Air Lines

Secretary:

G. W. Gilmer, Arabian American Oil Co.

Members:

R. C. Bergh, Republic Aircraft Corp.

H. F. Law, Port of New York Authority

J. C. Terry, Bureau of Aeronautics, USN

A. W. Cook, Goodyear Tire & Rubber Co.

O. L. Wilkinson, Hydro-Aire, Inc.

C. M. Donaldson, Wright Air Development Center, USAF

C. A. Solt, Jr., Wright Air Development Center, USAF

The arrows indicate the surfaces of the Beechcraft Twin-Bonanza which are substantially 100% magnesium. Advances in magnesium forming described below hastened the advent of the material in these applications.

Four Hot Forming Accelerate

AT BEECH we find magnesium a desirable material for skin covers for control surfaces and interior panels within the cockpit. The material's inherent weight benefit plus its ease of forming and handling make it a natural for these applications.

Each year Beech is realizing the benefits of magnesium to a greater extent. See the photo above.

Beech hot forms magnesium with four basic machines: (1) hydro press, (2) drop hammer, (3) punch press, and (4) power brakes. In all cases the tools or material are heated electrically.

Magnesium handling requires a directed effort to avoid corrosion. The material comes from the mill in crates, with a light oil coating that's left on the parts through all operations up to forming. All sheet now also has an acetic-nitrate pickle finish. This finish furnishes corrosion protection by removing surface impurities, rolled-in mill scale, and iron pick-up from the rolls.

Hydro Forming

Before forming, the parts are vapor degreased to eliminate all oil. They are immediately re-oiled after any forming operation.

The procedures and methods at Beech described below are not all in accord with accepted hot forming practices. But they have been found most satisfactory on a production basis.

1. Hydro Forming

Most parts are hot formed on the hydro press using the Guerin process. That's because this forming method is best suited to magnesium. Main use of the hydro press is in forming simple, straight, or flanged patterns, and in producing beads in flat areas.

The hydro blocks are mostly made of kirksite. The material and form blocks are run at the same temperature. That together with the nature of the basic fabrication procedure obviates an expansion correction in the kirksite blocks. Cast magnesium and aluminum are comparable to kirksite for this type of tool.

The platen or table is heated by electric strip heaters thermostatically controlled between 250 and 525 F. Temperature depends on the part, size of form block or die, and formability of the particular magnesium lot.

Note in the photo at left that the hot plate is on a loading table which hydraulically feeds to the press. At the top of the picture is a hoist and angle frame supporting the heat-resistant rubber pad, which can be swung completely out of the working area.

Note the stack of cold parts which, when placed on the heated dies, get hot enough by the time forming takes place so that they need no preheating. On the table are a long spar, and aluminum, kirksite, and steel dies.

R. H. Owen, Beech Aircraft Corp.

Based on paper "Hot Magnesium Forming" presented at SAE Wichita Section, Nov. 13, 1954. This paper is available in full-in multilith form from SAE Special Publications Department. Price 50¢ to members, 60¢ to nonmembers.

Methods Magnesium Usage

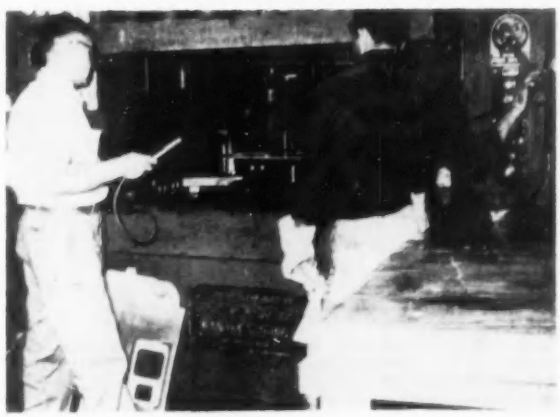
2. Punch Press Forming

Punch presses, as shown below, are used for form parts not adaptable to hydro, because of either severe draw of formed sections or amount of draw and quantity of parts required.

Forming speed is extremely important. It should produce a uniform stretch rate over the entire formed area. Hydraulic presses with a ram speed of 10 in. per min. or slower offer the best deep draw formability. Magnesium requires the least deep drawing pressure of all materials, but should be completely formed in a single stroke to prevent abnormal grain growth. During reheating, localized overheating at bend areas will often cause undesirable grain growth.

Material temperatures of 500 to 550 F are essential for best performance and control and lowest possible yield strength in compression. Only those portions of the die actually in contact with the material being formed need be at temperature.

Punch Press Forming



3. Drop Hammer Forming

Drop hammers are used wherever possible to avoid the high cost of punch press tools. But this forming method is not very suitable for several reasons . . . temperature variations during the several hits to form a part, extreme drawing speeds, and undesirable working conditions created by handling the material at high temperatures.

When annealed magnesium sheet is formed at 550 F, its formability approximately equals that of 24S-O. The actual forming is similar to cold forming of aluminum.

Drop hammer tools, both punch and die, are usually made of kirksite. Kirksite cannot be electrically heated satisfactorily because of impact shock and high creep rate at forming temperatures. Dies have to be oven heated to 300 F to prevent the heated blank from cooling too rapidly when it comes in contact with the die. This applies only to critical form parts.

4. Brake Forming

Here again magnesium is comparable to 24S-O aluminum when formed in the power brake if proper attention is given to minimum bend radii, forming temperature, and time at temperature.

Normal brake dies inserted in heated shoes, thermostatically controlled, are attached to the brake upper ram. Care must be taken on forming speeds. The brake is considered a fast machine, even though the ram is stopped on contact with the part before forming. Very few parts are brake formed at Beech.

Safe Very-High-Speed Tire

. . . is possible

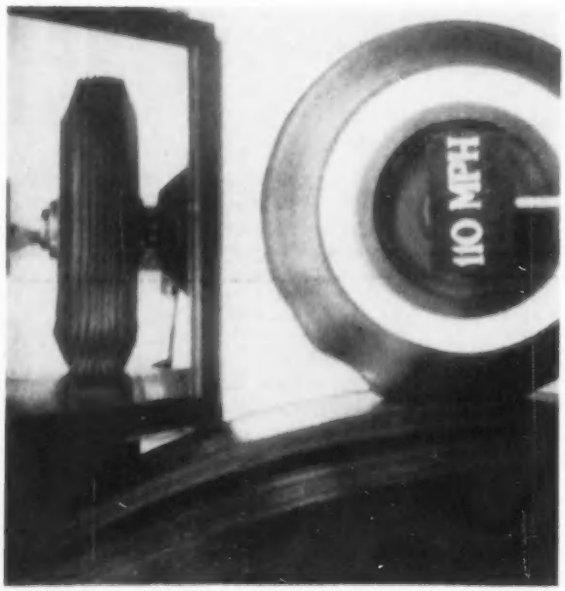


Fig. 1—Radial and cross-tread distortions in a standard tire are easy to see at 110 mph. At this speed, inertia effects predominate in the total power consumption.

SAFE very-high-speed operation of conventional present-day tires (above 90–95 mph, say), is limited by power consumption, a term used in tire men's parlance to designate the conversion of mechanical energy to heat energy.

The seriously high temperatures resulting from large power consumption lead to deterioration of rubber and cord materials. Together with high centrifugal forces (Fig. 1), this results—in a surprisingly short time—in a "separation" type failure. In this most common high-speed type of tire failure, either a section or the whole tread lifts from the carcass.

With few exceptions, the present standard tire performs satisfactorily for all driving needs, even at very high speeds. This is due primarily to the limited duration of travel at those speeds. It is probable that higher engine power and modern superhighways will create new requirements for safe passenger car tire performance at very high speeds as driv-

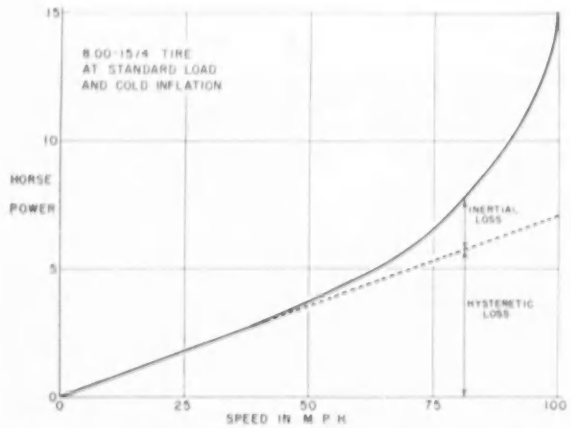


Fig. 2—Power consumed on a 4-ft dynamometer roll by a free-rolling tire at equilibrium. Note that in the speed range below 50 mph, hysteresis accounts for power consumption of the tire, while at speeds above 50 mph inertia effects constitute an increasingly larger share.

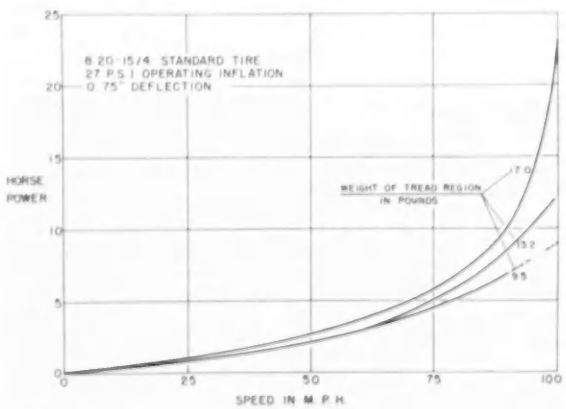


Fig. 3—Lighter-weight treads decrease power consumption considerably at higher speeds and contribute to safer operation. For the lightest of the three treads, the critical 10-hp power consumption point is not reached even at 100 mph.

Operation . . .

with compromises in cost and tread wear

E. H. Wallace and S. A. Lippman,
United States Rubber Co.

Based on paper "Operation of Passenger Tires at High Speeds" presented at the SAE Golden Anniversary Summer Meeting, Atlantic City, June 13, 1955.

ing habits change to higher speeds. Current tires, however, operating at the higher speeds are close to their safety limit. Tomorrow's requirements may be beyond it.

Power Consumption

Power consumption, manifest mainly as heat, is surprisingly high at higher speeds, and is due to mechanical hysteresis and inertia effects (Fig. 2). Hysteresis loss represents work of deformation which is not recovered when the tire parts are undeformed. This loss is proportional to the number of times the parts are flexed: thus, hysteresis loss varies linearly with speed. Inertia losses, on the other hand, seem to originate in the slow adjustment of the tire structure at high-speed operation.

At some threshold speed, the structure adjusts so that a portion deformed in contact with the pavement resumes its shape after leaving the pavement. Below that threshold speed, the structure is always in instantaneous adjustment. At higher speeds, it is unable to adjust fast enough. Compressions and distortions build up, eventually producing forces sufficient to throw the tire structure back into place.

Other dynamic effects in addition to inertia may occur. The result of all these actions and reactions is large power consumption.

These effects are illustrated for a typical tire in Fig. 2. Up to about 50 mph, power consumption is due mostly to hysteresis of tire materials and varies linearly with speed. At higher speeds, where inertia effects increase power consumption, the increase is exponential rather than linear.

Tire distortions in the radial plane and across the tread which lead to inertia losses are shown in Fig. 2.

For conventional passenger tires produced in the industry today, a convenient rule-of-thumb for gaging the limit of safe tire operation is a power con-

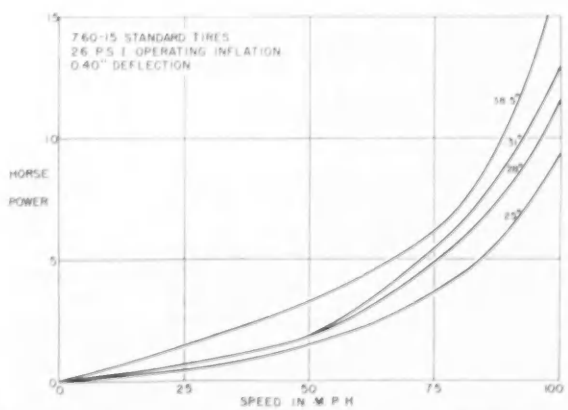


Fig. 4—Effect of cord angle on power consumption. Smaller cord angle promotes safety of the high-speed tire. With 25 deg cord angle, power consumption is less than 10 hp even at 100 mph. Cord angle and tread weight are designer's chief controls on power consumption.

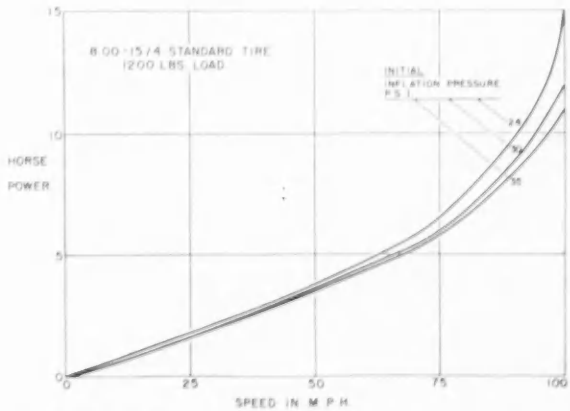


Fig. 5—The higher the initial inflation pressure, the less the power consumption. The higher initial pressure imparts a higher stiffness to the tire, thereby decreasing inertia losses. At the same time, unfortunately, riding comfort is decreased.

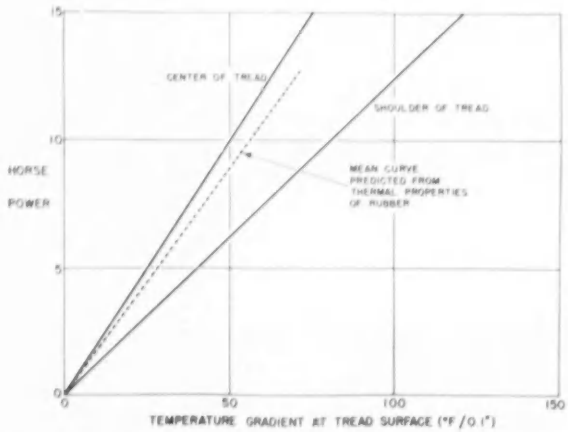


Fig. 6—Heat flow through tread agrees in general with power consumption. Theoretical studies also indicate that most of the power consumption is dissipated as heat flowing through the tread.

sumption of 10 hp. This represents about all the power a tire can dissipate as heat without becoming dangerously hot.

Reduction of Power Consumption

Safe very-high-speed operation will depend on reduction of power consumption. Most efforts have been directed toward reducing inertia losses inasmuch as this will yield the maximum safety returns at very high speeds.

Reducing weight of the tire crown reduces distortion, and consequently, power consumption, at high speeds, Fig. 3. It is quite correct to assume that a worn tire is superior to a new one for high-speed operation, provided the carcass of the worn tire has not been subjected to any unusual deteriorating action. Thus, a tire designed for high speeds may provide reduced mileage by virtue of a thin crown. This penalty must be paid in the interest of safety.

Increased inflation pressures and decreased cord angles, Fig. 4 and 5, will increase the tire stiffness and reduce the high-speed distortions illustrated in Fig. 1. Increased inflation pressures, however, result in a considerable loss in driving comfort. Tread weight and cord angle, then, are the major factors involved in design for safe high-speed tire operation.

Heat generated in the tire is a measure of power consumption. In fact, heat is the primary problem. Inflation pressure buildup from heating of tire air reflects a small portion of the total power consumption. Theory and verifying experimental data show that most of the power consumption is dissipated as heat flowing through the tread, Fig. 6.

What's Ahead?

Tire manufacturers will be ready to produce tires meeting demands imposed by the possible future trend to higher-speed driving. Major improvements can be expected from design and construction changes. Considerable improvement in the physical properties of tire materials will increase safe high speeds only a few miles per hour.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

Power-Shift Transmission . . .

. . . is a "must" for farm tractors. Even if it adds to cost, it will be accepted because it has a solid functional value as well as gadget appeal.

Based on paper by **C. A. Cook** Clark Equipment Co.

FARM tractors have come a long way, but there still remains one major development in crying need. There should be a means for shifting gears or changing from one ratio to another without interrupting the flow of power to the wheels. This is the finding of a recent survey made of the farm equipment industry.

In contrast to the universal interest manifested in power-shifting, there appeared to be no practical need expressed for automatic gear shifting. An increase in the number of speed ratios was forecast and the majority opinion indicated the desire for six to eight well-spaced speeds. One field request was made for 10 speeds to get more effective coverage and range.

This survey revealed only mild interest in the torque converter as part of the farm tractor transmission. A few companies have made extensive tests and more will be carried on to evaluate the torque converter drive. To make the converter at all feasible, an output shaft governor is considered essential for maintaining uniform ground speed. Then, in addition to the usual engine governor there would be required an independent drive for the power takeoff (PTO) or a governor control to maintain specified speed.

The "live" or "independent" PTO is accepted as standard today. We also have hydraulic PTO creeper drives and electric PTO's. The old SAE 535-rpm standard will not cover all of today's multipurpose demands. PTO speed in relation to ground speed rather than engine rpm is now available and is valuable for planters and fertilizer spreading. Multi-speed PTO drives seem, therefore, to be in the future picture. (Paper "Transmissions—Today and Tomorrow" was presented at SAE Golden Anniversary Tractor Meeting, Milwaukee, Sept. 14, 1955. It is available in full in multilith form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

Alloy Steels and Protective Coatings for JET ENGINES

H. J. Noble and W. H. Sharp,

Pratt & Whitney Aircraft, Division of United Aircraft Corp.

Based on paper "Steels and Protective Treatments for Use Up to 1000 F" presented at the SAE Golden Anniversary Summer Meeting, Atlantic City, June 14, 1955. This paper will appear in full in the 1956 SAE Transactions.

IN addition to the usual physical and mechanical properties of importance when selecting steels for application at temperatures up to 1000 F, due consideration must be given also to other properties including stress-corrosion, formability, and cost and availability of the strategic alloying elements. Unless the application justifies austenitic stainless steels the final choice usually will be made from either

- Low-alloy constructional steels.
- Martensitic chromium steels.

A number of steels representative of those used extensively in the aircraft engine field, together with their compositions, are grouped categorically in Table 1.

Low-Alloy Steels

Low-alloy steels are preferred where operating temperatures fall within the useful range for these types, and when suitable protective plates, metallic sprays, or paints can be applied. Fabricating problems, complexity of shapes, and ultimate operating conditions dictate the choice of both protective coating and steel. Suitably protected, some low-alloy steels find application in highly stressed parts operating up to 1000 F.

Protective Coatings

Organic coatings—Few currently available organic coatings are effective for heat and corrosion protection of low-alloy steels in turbine engines. Among their limitations are very short life when exposed to elevated temperatures and relatively poor scratch and abrasion resistance. An exception is an aluminum-pigmented silicone resin which serves satisfactorily at as high as 700 F has been developed and applied.

Electroplates—Cadmium and zinc plates provide good corrosion protection up to 500 F. Above that, they oxidize. Erosion and scratch resistance are comparable to those of the organic coatings available. These plates are superior to organic coatings in that they afford sacrificial galvanic protection to the base metal.

Nickel deposited in thin plates and then heated to 1000 F provides improved corrosion resistance. Plating baths containing organic addition agents are used for stress control or increased hardness or brightness. Recent work with such baths has produced electroplated nickel of high hardness and good ductility, with no noticeable effect on oxidation and corrosion resistance. High hardness or beneficial stress so obtained is reduced on subsequent heating.

Chromium plate has good abrasion resistance, and in adequate thicknesses possesses good oxidation and corrosion resistance up to 1000 F. Room temperature fatigue tests on low-alloy chromium-plated steel specimens previously heated to 750–1000 F show no loss in fatigue strength. Loss of hardness after heating to 750 F is negligible. Continued heating to 1000 F results in some hardness loss, but abrasion and galling resistance are not affected.

Silver plate is beneficial for galling or wear resistance under dry conditions up to 700–800 F. At

Table 1—Representative Steels for Use at Temperatures Below 1000 F

AMS OR PWA Specification Bar, Forging Sheet, Strip		SAE TYPE OR BRAND	Nominal Composition, %								
			C	Cr	Ni	Mo	Si	W	V	S	Ti
Low-Alloy Constructional Steels											
6280	6355	8630	0.30	0.5	0.55	0.2	—	—	—	—	—
6322		8740	0.40	0.5	0.55	0.25	—	—	—	—	—
6415		4340	0.40	0.8	1.8	0.25	—	—	—	—	—
6302		Timken 17-22A(S)	0.30	1.25	—	0.5	0.65	—	0.25	—	—
PWA 722		Bethlehem Templex or Timken 17-22A	0.45	0.95	—	0.55	—	—	0.3	—	—
Martensitic Chromium Steels											
5613	5504	51410	0.12	12.5	—	—	—	—	—	—	—
5610		51416F	0.12	12.5	—	—	—	—	—	0.25	—
5615		51414	0.12	12.5	2.0	—	—	—	—	—	—
5616		Greek Ascoloy	0.15	13.0	2.0	—	—	3.0	—	—	—
5630		51440C	1.10	17.0	—	0.5	—	—	—	—	—
Austenitic Stainless Steels											
5637	5515–5517	30302	0.15 max	18.0	8.5	—	—	—	—	—	—
5640		30303F	0.15 max	18.0	9.0	—	—	—	—	0.25	—
5645	5510	30321	0.08 max	18.0	10.0	—	—	—	—	—	0.60
5648	5524	30316	0.08 max	18.0	13.0	2.3	—	—	—	—	—

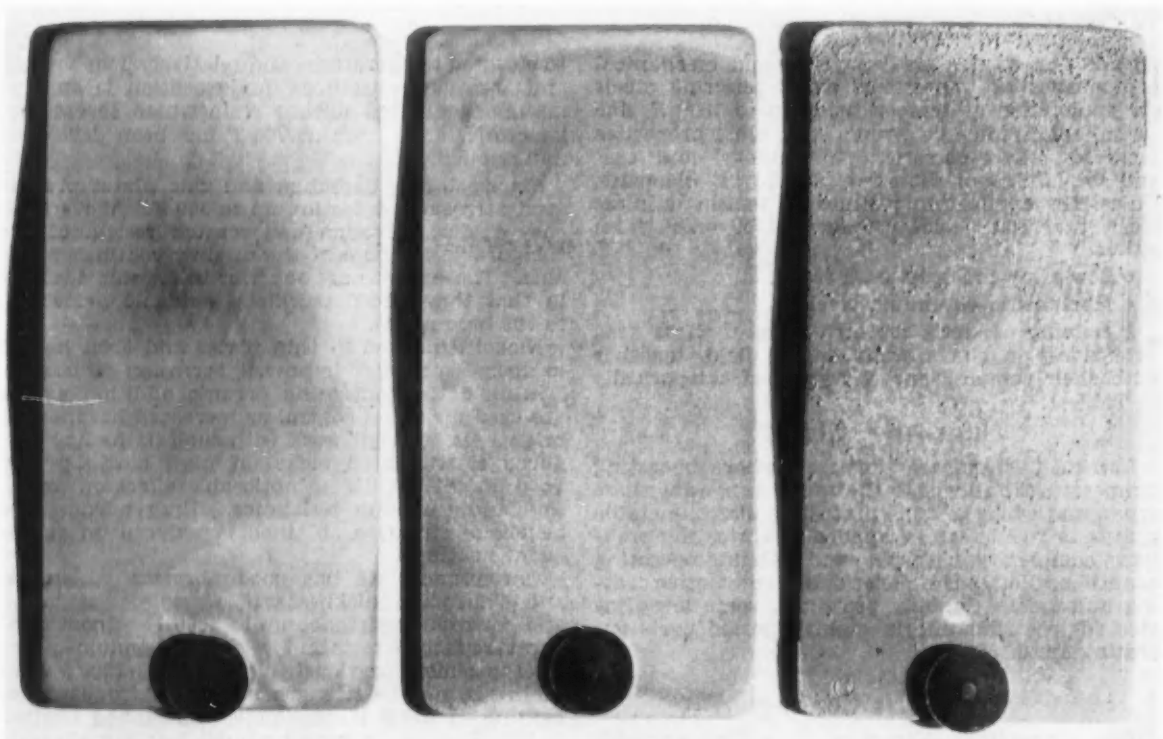


Fig. 1—Examples of cadmium plated on steel (left), and on nickel plate over steel (center and right). Cadmium plated on bare steel (left) and on insufficient thickness of nickel (center) presents a "balled" fused surface. Cadmium plated on proper thickness of nickel presents a smooth fused surface (right).

about 1000 F, oxygen diffuses through the plate and breaks the bond. Corrosion protection is lost because the resulting blisters flake off the surface.

Electroless nickel—Nickel is deposited without the use of electric current, but depends on a chemical reduction process in the bath. The plate is a precipitation-hardening nickel-phosphorus alloy whose hardness and brittleness increase with phosphorus content and on heating. Pratt & Whitney has obtained a maximum hardness of 1000 DPH (Vickers Diamond Pyramid Hardness). While more expensive than electroplated nickel, a large advantage lies in the very uniform plate thickness obtainable in recesses and on sharp edges provided the bath is agitated sufficiently to keep fresh solution in contact with the areas to be plated. Limited experience indicates good oxidation and corrosion resistance can be expected at least up to 1000 F. Electroplated and electroless nickel plate behave similarly with respect to corrosion resistance and hydrogen embrittlement. Both respond to the same relief treatment for the latter.

Diffused nickel-cadmium plate—This is the most promising combination plate developed to date. After deposition, heating to a temperature slightly above the melting point of cadmium allows diffusion into the nickel (see Fig. 1). Diffusion must be accomplished with the part unstressed to prevent molten metal from penetrating beyond the nickel

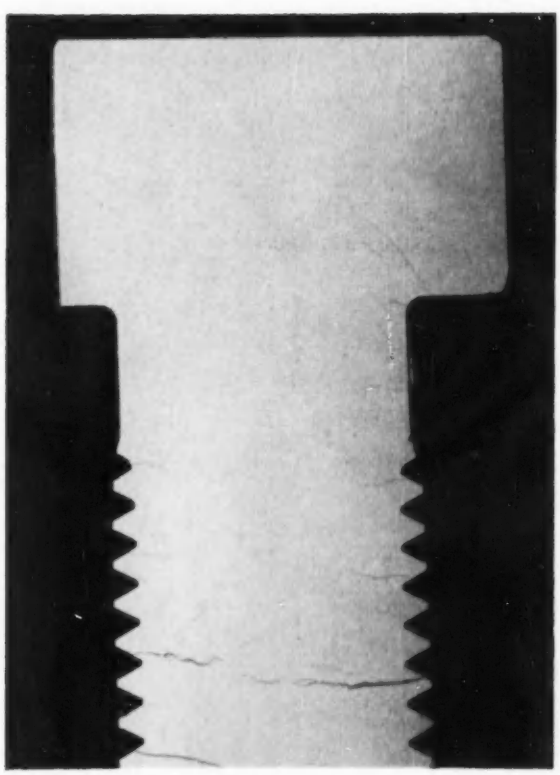


Fig. 2—Indium-plated AMS 6322 bolt with stress-alloying shows cracks after heating at 825 F under high stress.

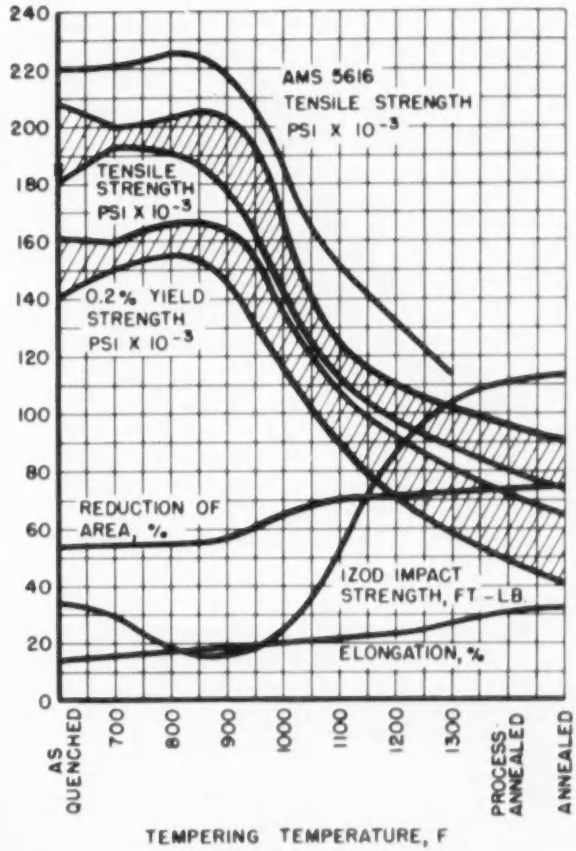


Fig. 3—Effect of 2-hr tempering temperature on tensile properties of AMS 5613 steel and on tensile strength of AMS 5616 steel. Note the better elevated temperature properties indicated for AMS 5616.

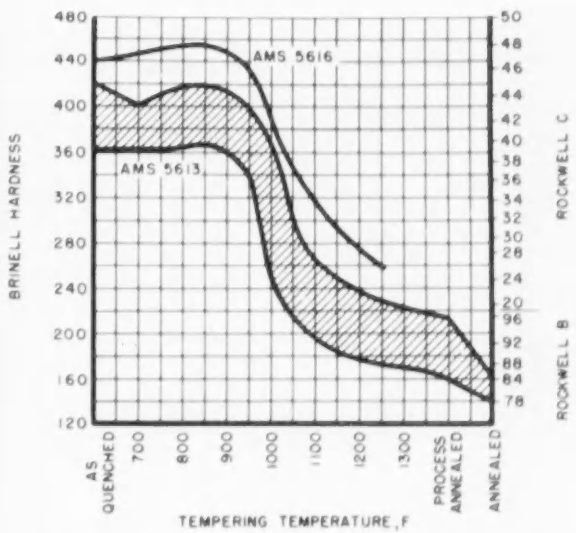


Fig. 4—Effect of 2-hr tempering temperature on hardness of AMS 5613 and 5616 steels. Again, better elevated temperature properties are indicated for the AMS 5616 steel.

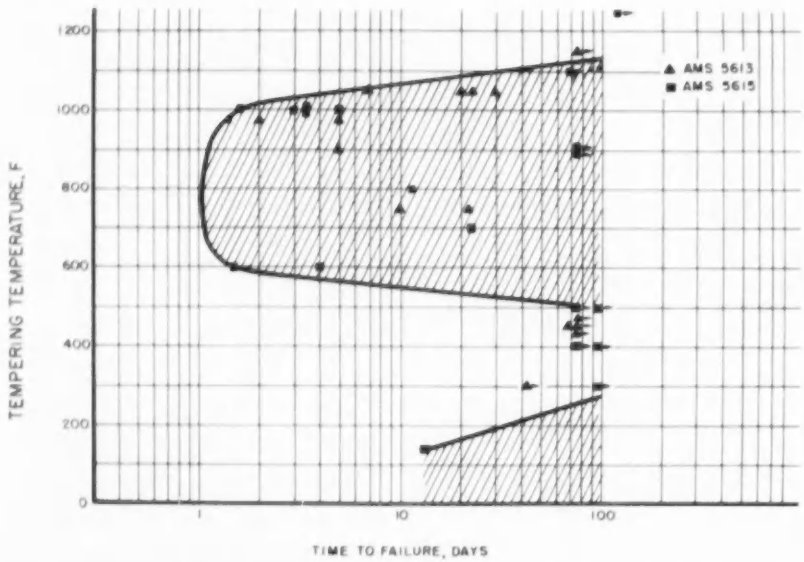


Fig. 5—Effect of tempering temperature on time to failure at a stress level of 80,000 psi for several heats of two martensitic chromium steels. The shaded areas indicate stress-corrosion susceptibility.

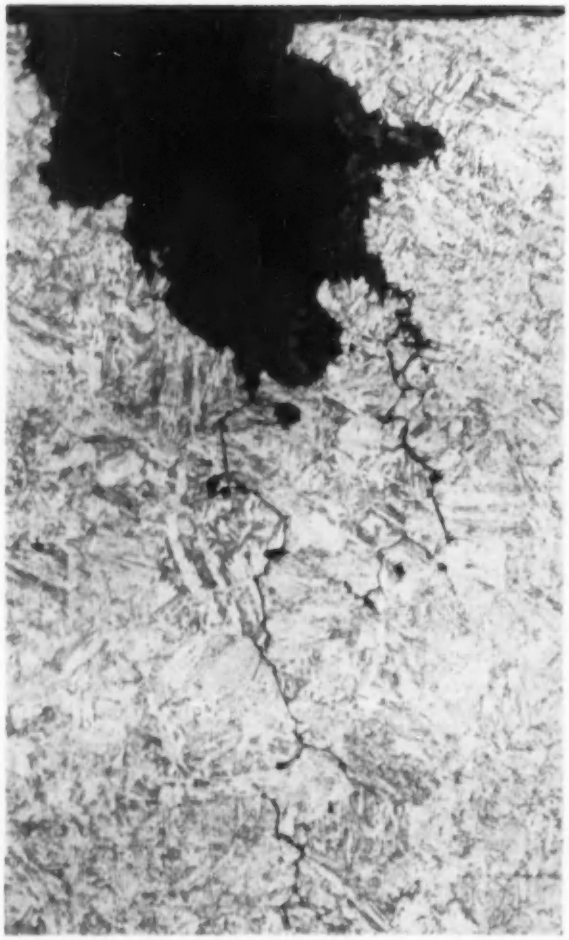


Fig. 6—Intergranular stress-corrosion failure starting from a corrosion pit in martensitic chromium AMS 5613 steel.

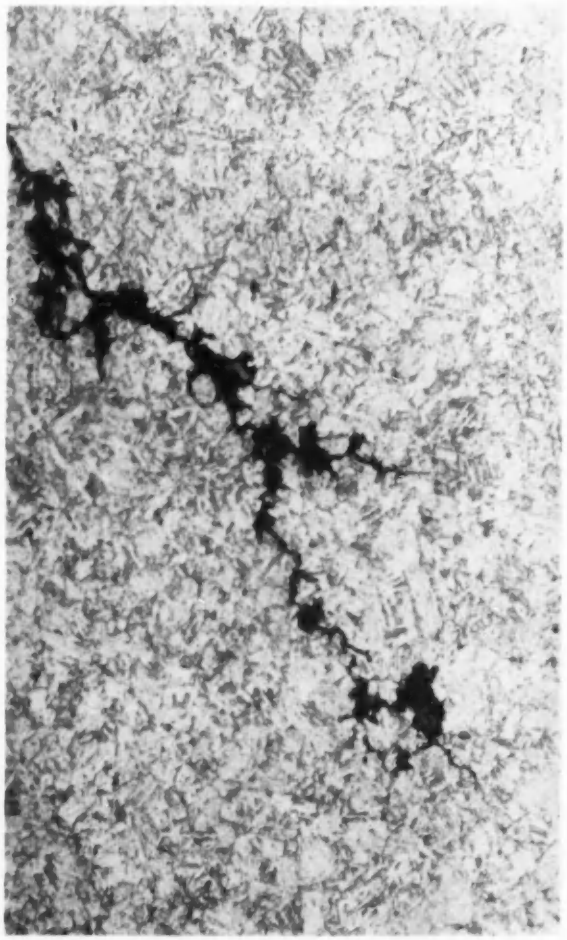


Fig. 7—Heavy corrosive attack following intergranular stress-corrosion cracks in a martensitic chromium steel.

into the steel. The principal advantages of this coating when properly applied are:

1. Combined coatings of 0.0005 in. are sufficient.

2. Corrosion protection is afforded up to 1000 F.

3. Galvanic protection is provided.

4. It does not cause stress alloying.

5. Stress-corrosion of martensitic chromium steels is prevented.

6. Fair to good anti-galling properties result.

7. Complex parts difficult to plate uniformly by other methods can be accommodated and still be adequately protected against corrosion.

8. Freedom from stress corrosion and stress alloying is obtained with as little as 0.00005 in. of nickel.

In general the process requires good control of plating bath and procedures, and the application of fixtures and conforming anodes as necessary. No Pratt & Whitney parts with this plate have failed, as far as the company knows.

There is one deterrent to the plating of cadmium —as well as indium, tin, and zinc. It is stress alloying, the catastrophic intergranular penetration of molten metal into underlying steel under stress. This results in almost immediate cracking, as Fig. 2 shows. Stress alloying can occur in service when operating temperatures rise above the melting point of the plate and the part is in tension. Laboratory data indicate that initial base metal hardness is the most influential factor in stress alloying. The harder the base, the more likely the failure.

Fig. 8—Progress of transgranular stress-corrosion cracks in an austenitic stainless steel. Note the absence of a corrosion pit at the surface where the crack originates.

Martensitic Chromium Steels

These steels combine the heat-treating qualities of low-alloy steels and a fair degree of oxidation and corrosion resistance. They excel for service below 800 F (Figs. 3 and 4).

For high-stress, low-temperature applications, precipitation-hardening austenitic stainless steels can be substituted for the martensitic chromium grades, but possess disadvantages in their higher strategic alloy content and instability when used above 600 F. In the hardened and tempered condition, martensitic chromium steels exhibit rust and corrosion resistance and high strength properties.

Nonmetallic inclusions and high ferrite content reduce fatigue strength of martensitic chromium steels. To this end, ferrite-free steels in this class are being developed. Careful manufacturing and cleaning methods are available to eliminate the problem of inclusions, especially on the surface.

High surface finish on martensitic chromium steels imparts superior rust resistance. Heat-treatment and surface contaminants such as iron particles or heat-treat oxide significantly affect rust resistance. Polishing, bright hardening in hydrogen atmospheres, acid cleaning, and abrasive blasting are employed to alleviate surface conditions tending to decrease rust resistance.

Stress-Corrosion

Stress-corrosion is a design consideration for all martensitic chromium steels. Hardness seems rather insignificant in this respect, but tempering temperatures above 500 F increase stress-corrosion susceptibility (Fig. 5). In general, double tempering doubles the average time to failure.

Passivation or other acid cleaning shows no significant effect on stress-corrosion, while shot peening under certain circumstances proves beneficial.

Tests conducted on martensitic chromium steels show that failure results from cracks starting at corrosion pits and progresses intergranularly (Figs. 6 and 7). Cracks in austenitic stainless steel, however, progress through the grains and result in transgranular failure even in the absence of pitting (Fig. 8).

For martensitic chromium steels in general:

- Those with highest tempering temperatures appear most resistant to stress-corrosion.
- Stress-corrosion cracking occurs intergranularly.
- Stress-corrosion resistance depends on hardness and tempering history.

(Paper on which this abridgment is based is available in full in multilith form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

E. H. Heinemann, general chairman of the meeting, and **B. F. Raynes**, general chairman of the production forum, watch the rehearsal.

THE television program "Success Story" honored SAE on Friday evening, Oct. 14, from 7:00 to 7:30 p.m. PST, on Station KTTV.

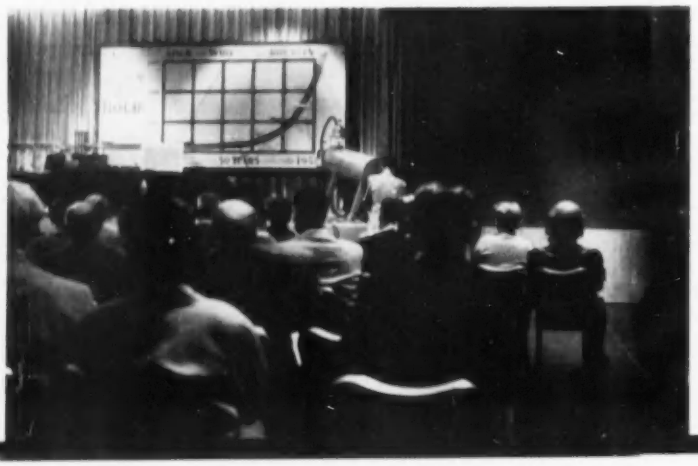
With sketches, interviews, and models, the program showed how SAE has contributed to

TV Comes

the advance of aviation by serving as a medium for the exchange of engineering information.

The performance constituted the Friday evening session of the meeting. It was sponsored by the SAE Air Transport, Aircraft, and Aircraft Powerplant Activities in conjunction with SAE San Diego Section, whose members provided much of the information and properties for the show. Commercial sponsor for the program was Richfield Oil Co.

Actual performance, shown in horizontal strip of pictures, featured a wall chart of aviation progress. Other sequences illustrated how in 1905, when the Society began, aeronautic enthusiasts worked individually, without exchanging findings freely. Then SAE brought them together. By World War I—symbolized by an early pilot's suit modeled by J. H. Famme—aviation was profiting markedly from SAE's activities. Now industry relies on SAE both for standardization and as a clearinghouse for other technical information of all kinds.



PICTURES AT LEFT SHOW A. T. Colwell explaining aims of the Society to the program's Ken Peters, and part of the audience watching the show as it was televised. Colwell represented SAE President C. G. A. Rosen at the television show and at various other functions throughout the meeting, since Rosen was unable to attend.

to SAE—Via L.A. Aero Meeting

OVER its 50-year history, SAE has contributed greatly to aviation progress by encouraging engineers to share information. This was the message of the television program "Success Story," which saluted SAE and the SAE Golden Anniversary Aeronautic Meeting on its half hour on Friday, Oct. 14.

The meeting itself, held Oct. 11–15 in Los Angeles' Hotel Statler, was a good demonstration of how SAE brings experts together to exchange ideas.

Nearly 1600 manufacturing men and design engineers jammed 15 panel sessions at the fifth SAE Aircraft Production Forum to be held in Los Angeles as part of an SAE Aeronautic Meeting. In panel after panel one could sense that manufacturing men have caught the "scientific fever" from their design engineering brethren and are introducing new manufacturing techniques and processes as fast as they can make them work.

Digital directors, electronic machine tool controls, precision forging methods, ultrasonic inspection, and intricate plastic tooling no longer are experimental curiosities.

Thanks partly to SAE, these and other manufacturing advances are speeding the delivery and enhancing quality and performance of current production airplanes, it was shown in panel discussions.

The same spirit of free communication pervaded the 10 technical sessions on the two days following the Production Forum. There was frequent recognition that only by knowing what the other fellow is thinking and doing does the engineer see where his work fits into the complete long-range picture.

As one speaker expressed it. "It's relatively easy to design the complicated. The simple takes much longer."

Implied in his talk and others was the idea that there must be a dual development effort, no matter whether the subject is an aircraft component, a system, or a complete vehicle. There must be a long-range program seeking the ultimate answer. There must also be an interim program making maximum use of the direction established by the long-range effort.

Both efforts bring more results faster if there is an interchange between the long-range and interim project men, both inter-company and intra-company. That's where SAE comes into service, speakers were fond of pointing out.

American Jet Transports

One of the less technical but more exciting revelations of the meeting was the first public announcement that an American flag airline had ordered a quantity of American jet transports. In concluding his paper on the DC-series transports, Arthur Raymond looked at his watch and said: "It's now 10:40 a.m. I've been authorized to tell you that the DC-8 has become a production airplane. Just 10 minutes ago Pan American signed a contract with Douglas for an order of DC-8's."

The news of this order and Pan American Airlines' companion order for Boeing 707 jet transports was the subject of conversations not only in session halls but through the corridors lined with exhibits in the bigger-than-ever SAE Aircraft Engineering Display and out around the Hotel Statler's huge pool.

Meeting participants did forgo their shop talk when Saturday evening rolled around. Then they and their ladies gave themselves over to the pleasures of the annual dinner-dance in the Statler's Pacific Ballroom.

The technical import of the Production Forum panels and of the technical sessions will be preserved through publications available from the SAE Special Publications Department. Panel secretaries' reports from the Production Forum will be reproduced just as soon as they are received at SAE headquarters and offered in a group as Special Publication SP-313 at $2.00 to members and $4.00 to nonmembers.

Complete papers presented in technical sessions are already available at 35¢

Arthur Raymond (left), Douglas' vice-president of engineering, with Dr. Lee A. DuBridge, president of California Institute of Technology. Raymond was toastmaster of the Friday, Oct. 14 luncheon. DuBridge was speaker.

OUR civilization and society will continue to need an increasing number of engineers and scientists if it's to advance, claimed Dr. Lee A. DuBridge, shown above at right, president of the California Institute of Technology, at the luncheon on Oct. 14.

The popular conception of some science fiction writers that the heavy work of the world of the future will be done by machines is a false one. Said DuBridge, the key figure of tomorrow is the man with his feet on his desk—THINKING. We can't run this nation with dopes. We need a large number of *uncommon* men to keep it going.

Several questions immediately come to mind. Are there enough human beings being born that have the capacity to think? Have we reached a limit to our intellectual resources? To what extent are intellectual abilities limited by genes and chromosomes, and how much intellectual development can we achieve by training?

DuBridge noted that today one in five going to college are getting degrees in science and engineering. There's slim chance that we'll increase this ratio to two in five. Let's not waste scientific manpower by having young engineers doing "squads right" in military service for two years, argued DuBridge. And let's not sidetrack engineering talent in industry.

DuBridge cited some statistics on where we stand today in the cultivation of our intellectual potential. Only 30% of our high school graduates enter college. And of the top 25% of our population in intelligence, only 42% go to college. Of the top 10%, nearly one half do not enter college.

What are the chances of satisfying our intellectual needs of the future? On the bright side, the absolute number of children reaching college age is increasing. So we'll have double the output by 1965. But if demand also rises, then we'll have a close race, concluded DuBridge.

each paper to members, 60¢ to nonmembers.

Future issues of SAE Journal will abridge each paper.

Highlights of each panel and paper follow:

COST CONTROL—A big problem today is the feed-back of cost information to design engineering during the beginning of a program so that the most economical "end product" cost is designed into the product. There's increasing use of cooperative liaison and cost reporting in the industry to get this feed-back.—panel on "Control of Manufacturing Costs"

NEW ROLE FOR QC—There's a real need for bringing quality control into the producibility picture to assist engineering, production, and tooling in the over-all picture. QC is changing from a purely inspection function to an agency for solving producibility problems.—panel on "Quality Control"

TOOL CONTROL TRENDS—The aircraft industry is putting more and more emphasis on tool schedules. There's also a real need for standardization in the estimating of tool costs and tool identification. — panel on "Tool Control"

MACHINING BY ELECTRONICS—Digital methods (the presentation of dimensional information to machines in numerical form) will become quite common in the next few years. The high cost of digital control equipment has been solved by divorcing the director from the machine by recording the director's output on magnetic tape.—panel on "Machining — Tracer and Profile"

TITANIUM GROWING PAINS—From a designer's standpoint, titanium is a natural in the 285 to 600 F temperature range. But as with any new material, the mill supplying the stuff and the user's plant fabricating it have to learn how to live with it. The material's uniformity and physical qualities are constantly improving. And the day when its cost will become more reasonable is not too distant. — panel on "Forming of Titanium and High-Strength Steels"

PRIME-SUBCONTRACTOR RELATIONSHIPS—Question: How can the prime contractor get what he needs from his subcontractors by way of process control without removing the sub's initiative?

Answer: (1) give him a clear-cut specification, (2) communicate with him regularly, and (3) educate him on your requirements.—panel on "Process Control"

PRECISION FORGINGS—In the case of plate stock and extrusion, the finished part weight is about 10% of the raw material weight. With conventional forgings, the finished part weighs 50% that of the finished forging. A root rib

precision forging yields a finished part weighing two-thirds the raw weight.—panel on "Forging Techniques to Reduce Machining"

FLIGHT CHECKOUT—One company is using the "one-time" flight check-off card. It's been developed into a sampling system requiring that only one out of eight airplanes need be customer flight checked.

This is possible only with an airplane having a long production life and where there's a great deal of experience available.—panel on "Engineering and Manufacturing Look at Flight Line Operations"

TOOLING FROM PLASTICS—The general trend in plastic tooling is toward the use of epoxy resins for masters, duplicate splashes, form dies, trim and drilling fixtures, and check fixtures. Paper honeycomb with epoxy laminate surfaces is being used for tool bases, surfaces tables, straight edges, and tooling bars as well as in other tooling applications.—panel on "Plastic Tooling"

NEW WING NEEDS—The thin, highly loaded wings of today's aircraft require the use of new construction . . . integral fuel tanks, integrally machined skins, integrally stiffened extruded skins, and use of new materials like titanium.—panel on "Wings"

LANDING GEAR TRENDS—New airplanes are requiring higher and higher tensile strengths in landing gears to reduce weight and space requirements. We're rapidly approaching the 350,000 psi range in tensile strength.—panel on "Landing Gears"

GUARDING AGAINST JET DAMAGE—Ways are being devised to reduce the damage to gas turbines from foreign objects getting into inlet ducts . . . run-up and taxi screens, more careful inspection, and better housekeeping of runways and run-up areas.—panel on "Powerplant Installations and Components"

FUSELAGE PROBLEMS—Basic interiors should be laid out on the basis of loft data. Structure tolerance data should also become a part of engineering design criteria. This should improve the relationship of outside contour to internal structure.—panel on "Fuselages"

COORDINATING PLANT LAYOUT—Getting a new plant layout across to all people concerned can be done with this four-part plan: (1) issue an advance notice of the move showing all the details and pinpointing responsibilities; (2) hold pre-move meetings; (3) assign a coordinator responsible for supervising the actual move; (4) hold post-move meetings to pick up all omissions in the move and to correct errors.—panel on "Plant Layout"

MAINTAINING PLANT EQUIPMENT—It's going to take much higher technical skills to maintain new machinery and equipment in the factory . . . an electrical engineer instead of an electrician for electronic equipment and a mechanical engineer instead of a plumber on hydraulic systems.—panel on "Preventive Maintenance and Equipment Replacement"

CONGRESSMAN CARL HINSHAW poses with Lt.-Com. Robert E. Apple of the Office of Naval Research just before the session at which Apple presented a paper on hydrofoil craft by Rear Admiral F. R. Furth. Hinshaw was chairman of the session.

CONSTELLATION MODEL 1649—To make possible east-west Transatlantic crossings against winter winds at full payload, we are going forward on the Constellation model 1649. It will have a wing with 12% more area, 33% increase in aspect ratio, and 46% greater fuel capacity. Its engines will be the EA-2 version of the Wright Turbo-Compound, developing 3400 hp for take-off and 2800 hp for flight.—**H. L. Hibbard** and **C. L. Johnson, Lockheed Aircraft Corp.**, "The First Constellation Decade"

DC-8 JET TRANSPORT—With the DC-8, our goal has been to produce a commercial airplane which is a big step forward in every respect—better combination of payload and range, higher speed, lower seat-mile cost—and at the same time maintain or improve upon the high level of service reliability that has been associated with past DC models.—**A. E. Raymond, Douglas Aircraft Co., Inc.**, "DC-1, 2, 3, 4, 5, 6, 7, 8, . . . n"

STALL AND SURGE—Compressor stall and surge occur when a particular limit of the compressor is reached. Whether it be the limit of a blade, a stage, or the compressor as a whole, it is the pumping limit of the particular item for the conditions under which it is operating.

Relatively small, high-frequency oscillations characterize stall. During surge, there are large-amplitude, sometimes violent oscillations separated by periods of what appears to be stall.

When any of the vibrations or their harmonics are in resonance with the natural frequency of the blade, high and even destructive resonant vibrations result.—**Maj. A. J. Gardner, Power Plant Laboratory of Wright Air Development Center**, "Are We Gaining on the Compressor Stall Problem?"

THRUST REVERSAL—Tests of target-type reversers show that 55–80% thrust reversal is possible. Thrust reversal is largely a function of reverser

Air Power Is Luncheon Topic

Production Forum Sponsor W. E. Beall (left) and Maj.-Gen. T. P. Gerrity. Beall, senior vice-president of Boeing, was toastmaster, and Gerrity, director of Air Force procurement and production engineering, was speaker at the luncheon on Wednesday, Oct. 12.

TO maintain supremacy in air power, we must shorten the cycle time between the start of a development and introduction of the weapon in combat inventory. That's what Maj.-Gen. T. P. Gerrity, director, Procurement and Production Engineering, USAF, urged at the Production Forum luncheon on Oct. 12.

Gerrity pointed out that Russia has been able to produce quality weapons in quantity, and in a relatively short time. He estimated that the Soviet air force might consist of some 20,000 aircraft in combat units, about three-quarters of which are jets.

Increasing weapon complexity is making it especially difficult to reduce development and design time. For instance, it took 140,000 engineering man-hours to design the B-17 as against the 600,000 man-hours required for the B-47. The bombing system for our World War II airplanes weighed 125 lb and occupied 5 cu ft. Today's system weighs 1 ton and requires 64 cu ft of space.

Gerrity urged engineers to exploit new ideas and new techniques to offset this trend brought about by complexity.

size and gas turning angle, with reverser lip angle being highly critical.

Cascade-type reversers offer about 75% thrust reversal without jet attachment. Cascade aspect ratio, blade design, and external doors have small effect on thrust reversal. Performance of ring cascades is sensitive to ring shape and spacing.—**J. H. Povolny** and **J. G. McArdle, Lewis Flight Propulsion Laboratory, NACA**, "NACA Investigation of Thrust Reversal Techniques"

ENGINE BLEED AIR CONTAMINATION—Air bled from the compressor of a turbine engine to air condition a cockpit is likely to carry odorous decomposition products of the engine oil. Chief problem involved with any decontamination system that does not completely eliminate the oil odor is the psychological hazard. The odor causes the pilot mental anxiety. When tension builds up, it may trigger a below-normal physical condition to bring on nausea.

Considering the demands on the pilot under combat conditions, we can't take the chance of nauseating him—or even making his eyes water. No odor or irritating fumes can be tolerated, many experts feel.—**H. A. Reddall, North American Aviation Inc.**, "Elimination of Engine Bleed Air Contamination"

FLYING HIGH—The higher we fly, the fewer gusts we encounter. For given number and intensity of gusts, we can fly about 10 times as far at 25,000 ft and about 100 times as far at 40,000 ft as at 10,000 ft. Ride roughness is cut approximately in half for each 5000 ft increase in altitude.—**Schuyler Kleinhans, Santa Monica Division of Douglas Aircraft Co., Inc.**, "How High Should We Fly?"

PROPELLER SYNCHROPHASER—Major part of the variation in the background noise level in multi-engine aircraft results from variations in the phase relationship between the propellers. Hamilton Standard's Synchophaser keeps the engines operating at the same speed, maintaining the noise level in the aircraft at a constant, near-minimum value.

Difference between the Synchrophaser and the earlier Synchronizer is that the older product does allow a slow variation in aircraft noise.—**C. B. Brahm, Hamilton Standard Division, United Aircraft Corp.**, "A Propeller Synchrophaser for Aircraft Noise Control"

SYNCHROPHASER PSYCHOLOGY—A loud low noise of varying loudness is extremely annoying. The fact that the 50-lb Synchrophaser keeps the fluctuations to a negligible level improves passenger comfort as much as a great many more pounds of sound-insulating material.

If the Synchrophaser should fail, it wouldn't hurt any of the other characteristics of the propeller.—**G. E. Sanderson, Lockheed Aircraft Corp.**, "The Influence of Propeller Synchrophasing on Aircraft Cabin Noise"

HUMAN ENGINEERING — Batteries are heavy and awkward to handle. Therefore, in the Convair 340, there is a battery elevator installed behind a large access panel. Within the large panel is a small door through which a crank is accessible for lowering the elevator to a convenient position.

This kind of human engineering thinking in the design of a transport keeps man from confounding himself with the complexity of his inventions. —**J. J. Alkazin** and **J. C. Hoover, Convair Division of General Dynamics Corp.**, "Air Transport Design for the Human Element of Airline Service and Maintenance Personnel"

RAIN EROSION TESTING—To study the effect of rain impact on possible airplane skin materials, test specimens are mounted in the nose of a modified 20-mm projectile and fired horizontally through 500 ft of simulated rainfall.

Nearly all specimens show some damage. Exposed aluminum has cup-shaped indentations similar to shot

peening. Clear resin has a circular surface cracking around what appears to be the periphery of the drop impact. Elastomeric coatings show a small island of coating material surrounded by bare base metal.—**W. L. Dittmann Convair Division of General Dynamics Corp.**, "Supersonic Rain Erosion Testing Techniques"

DYNAMIC LOADS ON STORES—Light-weight stores, like electronic packages, are subject to higher accelerations than are at present specified for determining the strength of airborne stores and suspension systems in landing conditions. While this discrepancy may not result in damage to the store suspension system, which may be critical for the heavier stores, like torpedoes or fuel tanks, it can result in service damage to the stores themselves or their components.—**S. B. Pfeiffer, El Segundo Division of Douglas Aircraft Co., Inc.**, "Dynamic Landing Loads on Stores"

REDUCING THERMAL STRESSES—Reducing restraint between skin and web reduces thermal stresses in wing skins. One way to do it is to change the stiffness of the web. If the web is designed to expand and contract freely with the skin while continuing to perform its functions of stabilizing the skin and carrying shear, thermal stresses are reduced. Webs with closely spaced vertical corrugations or pin-jointed trusses meet these requirements.—**R. R. Heldenfels, Langley Aeronautical Laboratory, NACA**, "Some Elevated Temperature Structural Problems of High-Speed Aircraft"

LANDING GEAR SPRINGS—A spring in the Constellation model 749 main landing gear drag strut damper was redesigned to save 17 lb. Being smaller, the housing weight was reduced. Since two were required, 55 lb per airplane was saved.

These springs have served well for over 20,000 service hr.

The weight saving was achieved by increasing the working stress more than 50%. This was made possible through use of pre-set and stress peen techniques applied to springs of unusually high quality.—**E. H. Spaulding, California Division of Lockheed Aircraft Corp.**, "Light Weight Springs for Limited Life"

HYDROFOIL CRAFT—Since a hydrofoil boat proceeds with the hull completely clear of the water, its drag is greatly reduced. A hydrofoil craft can attain a particular speed with only half the power as a similar displacement boat requires. In rough water, both speed and riding qualities of hydrofoils are vastly superior to those of either a displacement or a planing craft.

Wake is negligible, even at high speeds. There's little motion when lying-to in rough water due to the damping action of the foils.—**Rear Admiral F. R. Furth, USN, Chief of Naval Research**, "Hydrofoil Craft: Present Status and the Central Problem"

Design-Production Is Theme

B. C. Monesmith (center) with B. F. Raynes (left) and A. T. Colwell. Monesmith spoke at the luncheon on Tuesday, Oct 11. Raynes, who was General Chairman of the SAE Aircraft Production Forum held Oct. 11-12, served as toastmaster. Colwell brought the greetings of SAE President C. G. A. Rosen, who was unable to attend.

WE'RE in a new era in the aeronautic industry, where the interdependence of knowledge of engineering and manufacturing have set the stage for teamwork. This was the theme stressed by B. C. Monesmith (center above), vice-president and general manager of Lockheed Aircraft's California Division, at the opening luncheon of the Aircraft Production Forum, on Oct. 11.

Not so long ago, said Monesmith, the typical aircraft company was headed by a man who was chief engineer, head of manufacturing, handled purchasing, arranged financing, and sometimes even acted as test pilot. The advance of the airplane and the growth of the industry has brought a host of specialists in both engineering and manufacturing, each of whom makes a vital contribution to the creation of the finished product.

"The catalyst needed to insure the ultimate in team work between these two functions is communication," said Monesmith.

And speedy communication demands clarity in written material, with the information slanted for the man who needs to know. But there's no substitute for face-to-face talk and conversation when problems arise involving understanding.

Monesmith cited the SAE Production Forum as a good example of face-to-face conversation. He pointed to the rapid growth of these Forums as evidence of their effectiveness in communicating ideas, reaching understandings, and clarifying problems.

AERODYNAMIC HEATING—We are now using the Bell X-1B rocket-propelled research airplane to study effects of aerodynamic heating on the aircraft structure and the distribution of heat through the structure. On a typical short flight, maximum stagnation temperature was 200 F. As expected, nose and skin temperatures did not reach this value because of the heat transfer time and recovery factor. Highest temperature reached on the nose and wing skin occurred after the maximum Mach number was reached. It was 170 F above free-air temperature.—**W. C. Williams, High-Speed Flight Station of NACA**, "Flight Research at High Altitudes and High Speeds with Rocket-Propelled Research Airplanes"

AIR CONDITIONING A BOMBER—During a maximum range mission, the

TYPIFYING THE GAIETY of the crowd attending the dinner-dance concluding the meeting on Saturday, Oct. 15, are Mrs. R. G. Sharp, wife of the chairman of San Diego Section, and J. T. Hamilton, chairman, Southern California Section

overall penalty imposed on a supersonic bomber by its air conditioning system is equivalent to an additional fixed weight of 3% of the airplane empty weight. This includes the effects of engine bleed air consumption, ram air drag, weight of evaporative liquid, and the fixed weight of the air conditioning system.

During a maximum speed mission, the overall penalty is equivalent to an additional fixed weight of 2% of the airplane empty weight.—**L. H. Schreiber, Convair Division of General Dynamics Corp.**, "Environmental Control on a Supersonic Bomber"

EXTREME ALTITUDE PROBLEMS—Vehicles relying principally on aerodynamic lift will probably have practical steady-flight ceilings not much over 100,000 ft. Further altitude increases will be the result of transient flight paths such as zooms or ballistic trajectories.

Vehicles employing ballistic trajectories to attain great heights will encounter special flying-quality problems. For example, basic weathercock stability will be lacking. Some means may be required for aligning the vehicle axis with the flight path prior to reentry into the atmosphere.—**E. R. Heald, El Segundo Division of Douglas Aircraft Co., Inc.**, "Stability and Control of Piloted Aircraft at High Altitudes"

NEED FOR DUCTING STANDARDIZATION—In the matter of pneumatic duct sizes, both fabricators and designers agree on the need for standardization. But they disagree on the fineness of standardization. Fabricators prefer to standardize on as few sizes as possible to minimize tooling investment. Designers prefer a fairly large selection of duct sizes to make it possible to fit design requirements precisely.

No doubt these two viewpoints could be reconciled—with benefit to both fabricator and designer—if we could get busy on a standardization program.—**W. M. Cattrell, Ryan Aeronautical Co.**, "The Design and Development of High-Pressure High-Temperature Pneumatic Ducting Systems for Aircraft"

BALL JOINTS FOR DUCTS—A ball joint has been developed which functions as a knuckle at the high pressures and temperatures encountered in aircraft pneumatic systems with negligible leakage.

A series of the joints incorporated into a duct system accommodates thermal growth and relative motion without impairing the basic tension-carrying characteristics of the duct.—**K. W. Goebel, Rohr Aircraft Corp.**,

Influence of Airports on Future Design

Fred M. Glass (left), speaker at the Thursday, Oct. 13 luncheon, with B. F. Coggan of Convair, who was toastmaster.

NO longer can engineers continue to develop civil aircraft, oblivious to the airport facilities on which these airplanes will have to operate, warned Fred M. Glass, Director of Aviation, Port of New York Authority. At his luncheon talk on October 13, Glass pointed out that we're about at the limit of runway length and strength.

He pointed out too that noise level of current jet-powered airplanes is another knotty problem. Said Glass: "I don't know whether four-engine turbine aircraft can operate without difficulty into New York International or Los Angeles on an unlimited frequency basis."

The heavy traffic, and it's still growing, at metropolitan airports creates another problem. For instance for a 7-hour period studied, the average outbound delay at La Guardia in New York was 54 min. That was about a year ago. Since then, the general traffic level has increased about 10%.

Helicopters further complicate the air traffic control picture. Glass predicted that new ways will have to be devised to handle helicopters so that they won't interfere with fixed wing traffic.

Aviation's growth depends now more than ever on cooperation between aircraft manufacturers, airline operators, and airport operators, Glass concluded.

"Compressor Bleed Ducting for Auxiliary Power Supply"

B-52 DUCTING — The production B-52 airplane incorporates a full-tension duct pneumatic system in the body of the airplane. Thermal expansion, duct misalignment, and structural deflection are absorbed in the wing, struts, and nacelles by bellows. In the body, loops, omega bends, and where possible the inherent flexibility of the normal duct configuration take care of duct variations.—**C. R. Peteron, Boeing Airplane Co.**, "Problems Encountered in the Development of the B-52 Pneumatic Ducting System"

AUXILIARY GAS TURBINES—An airborne gas turbine auxiliary power unit is the most convenient way of supplying ground air conditioning, electrical power, and pneumatic power for starting.

The fire hazard is no greater than with the main engines, combustion heaters, or fuel air starters.—**J. T. Bartlett** and **P. C. Scofield, AiResearch Mfg. Co.**, "Auxiliary Power and Air Conditioning for the Self-Contained Airplane"

HIGH-DIELECTRIC PLASTIC—Finely divided titanium dioxide added to polystyrene gives an antenna lens the high dielectric constant it needs. A single milling operation on a two-roll mill disperses the titanium dioxide satisfactorily in the plastic. The titanium dioxide constitutes up to 68% by weight of the mixture.—**Willard Crofut** and **L. B. Keller, Hughes Aircraft Co.**, "High-Quality Plastics Components for Use in Guided Missile and Airborne Radar Systems"

TURBINE ENGINE SUSPENSIONS—Rotor unbalance, gearing disturbances, gas flow turbulence, and propeller mass and aerodynamic unbalance all represent sources of vibratory energy which make the turbine powerplant an exciter of considerable output.

The flexible engine suspension has to protect the airframe against all these sources, as well as protecting the delicate engine against all the loads the airframe can impose on the engine. —**Jack Rebman, Lord Mfg. Co.**, "Flexible Suspensions for Turboprop and Turbojet Power Plants"

FAIL SAFE AIRFRAME DESIGN—Of the two principal approaches for insuring against catastrophic fatigue failure, the fail safe approach is sounder than the "safe life" method.

With the current state of the art, we're better able to design a fail safe structure which will sustain limit loads with any one of its elements failed than we are to predict the safe life of the structure on the basis of expected loading history and material characteristics.

From the fail safe standpoint, 24ST is superior to 75ST. Underwater pressure testing is probably unnecessary. Fatigue cracks can be quickly simulated in the laboratory. And dynamic overstresses in fail safe tests are probably small.—**J. F. McBrearty, Lockheed Aircraft Corp.**, "Fatigue and Fail Safe Airframe Design"

Manly Award Winners with Award Chairman

JOHN TYLER (LEFT) AND E. C. PERRY JR., received Manly Memorial Award scrolls and medals from R. R. Higginbotham (right), chairman, Manly Board of Award. Their paper on jet noise earned them the Manly award for papers presented in 1954, as well as the Wright Brothers Award, which they received at the SAE Aeronautic Meeting held last spring in New York.

INTEGRATE THE AIRCRAFT INSTRUMENTATION—All aircraft require fundamentally the same instrumentation—that to supply the data which enable the pilot to put the airplane in the proper position with respect to either a fixed or a moving point.

This requires a wide variety of data —too many indications for the pilot to assimilate item by item. The data must be integrated for the pilot rather than fed to him haphazardly. Even the modern miracle computers require that the input data be properly processed. The human brain requires the same consideration.—**Com. G. W. Hoover USN, Office of Naval Research**, "Integration of Aircraft Instrumentation"

PRESSURE RATIO COMPUTER—The Microjet Control senses pressures and computes pressure ratios separately or in relation to other engine parameters such as rpm and fuel flow. It's simple and reliable. And, unlike earlier pressure-ratio-measuring devices, it does not depend on a precision bellows. Instead, the Microjet uses a single nonresilient diaphragm. It has no wearing parts.—**W. E. Reed, Solar Aircraft Co.**, "A New Approach to Turbojet and Ramjet Engine Control"

WHEN A TURBOPROP WINDMILLS —One-engine-out control on a two-engine turboprop airplane is a serious problem. Two additive aerodynamic effects consume a large part of the airplane's lateral control capability. First, the wake of the windmilling propeller decreases the lift on the wing behind the propeller, imparting a rolling moment to the airplane. Then, the drag of the windmilling propeller yaws the airplane and a rolling moment results. The dihedral effect of swept wings is extremely large, so a swept-wing airplane may be very critical in this respect.

To the designer of feathering equipment, this means that a relatively high pitch stop location must be used to maintain adequate control at take-off speeds in the event of an engine failure. If autofeathering is used during take-off, the high pitch stop requirement remains because a safety back-up is necessary in case of autofeathering malfunction.—**M. E. Kirchner, Boeing Airplane Co.**, "Turboprop Airplane Control Problems Associated with Engine Failure Considerations"

Tire Thump . . .

. . . has been defined in terms of tire vibrational characteristics. A meter has even been devised to measure it. But what to do to cure thump still stumps the experts.

Based on paper by **David C. Apps and George M. Vanator** General Motors Proving Ground

TIRE thump is due to the simultaneous excitation of at least two audio frequency sound components which are adjacent harmonics of wheel rotational speed and which have approximately equal sound pressure amplitudes. These components interfere with each other and produce a beat frequency which is heard as tire thump.

Thump severity is the combined effect of tire excitation and response characteristics of the car in question. And only those frequencies in the band 20–70 cps need be considered to obtain a quantitative measure that will correlate with a personal reaction to tire thump.

It is also fact that with only one thumping tire and speed adjusted to a thump period, the thump severity will not change with time. However, with two thumping tires, operating at the same road speed, the thump severity will be observed to increase and decrease periodically; that is, phasing occurs. Except for this phasing, the resultant effect on a car of two thumping tires is no different from that of a single one. We hear only one thump per wheel revolution.

The principle of the tire thump meter is based on measuring the amplitude, or "depth of modulation," of the beat between two frequencies. It was reasoned that this depth might be directly related to one's personal rating of thump. Fortunately, this is generally true, and a meter was designed and built that measures this modulation depth on an arbitrary scale of 1 to 10.

Principal components of the meter are shown in Fig. 1. The microphone placed at a passenger's ear position inside the car senses the total incident sound and produces a voltage which is a facsimile of the sound. There are many other sounds totally unrelated to thump which must be rejected by the instrument. These are filtered out by the 20–70 cps band-pass filter so that the familiar beat pattern is apparent. The signal is then demodulated and passed through a 10-cps low-pass filter. This removes the "carrier," so to speak, leaving the desired modulation envelope which is measured by a voltmeter circuit with a long time-constant. Note that the meter rejects all pure tones regardless of frequency because they do not constitute tire thump.

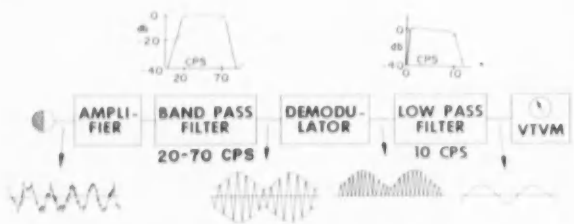


Fig. 1—Principal components of the General Motors thump meter are shown in this block diagram. Extraneous sounds are filtered out by a 20-70 cps band-pass filter. The signal is then demodulated and passed through a 10-cps low-pass filter. The desired modulation envelope is measured by a voltmeter circuit with a long time-constant.

The instrument is basically simple. However, psychoacoustic tests showed the necessity of incorporating several rather unusual response characteristics in the various circuit components. The first of these is the shape of the frequency response curve of the 20–70 cps band-pass filter. It was necessary to have a response curve as represented by the dotted line in Fig. 1 rather than a flat-topped curve as shown by the heavy line. This curve rises at the rate of 9 db per octave between the frequency limits of 20–70 cps.

The second consideration is in the demodulator circuit.

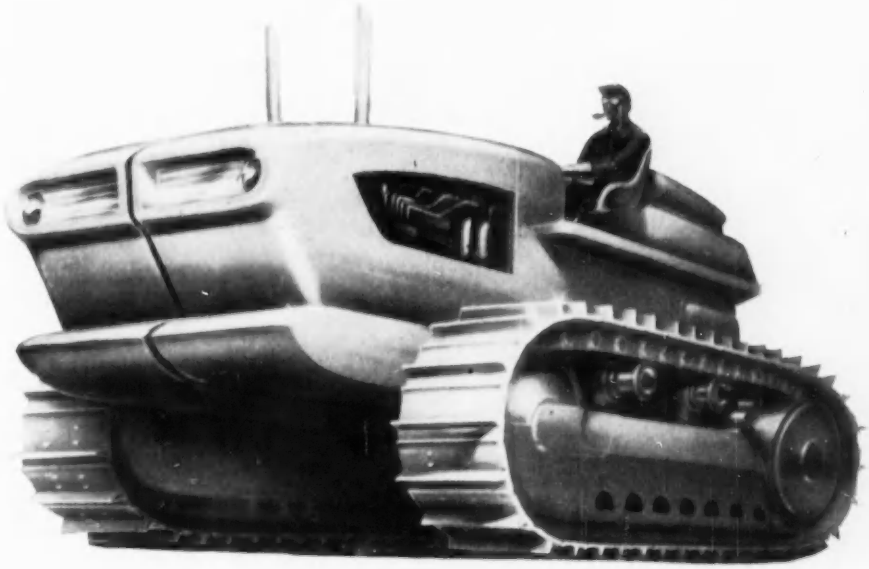
It has been stated that one's personal rating of thump is related directly to the depth of modulation of the beat envelope. This is strictly true only when two frequency components producing a beat are equal in amplitude and the beat pattern, or modulation envelope, goes to zero. In this case, when the depth of modulation is doubled by doubling the amplitude of both components, the impression of thump severity is doubled.

On the other hand, when the two frequency components producing a beat are not equal in amplitude, the impression of severity is not directly proportional to the depth of modulation but is a function of both the ratio of the two signal amplitudes and the depth of modulation. It can be shown mathematically that with two signals of unequal amplitude the depth of modulation is always equal to the amplitude of the smaller signal.

Typical ear response measurements for unequal components necessitated adding a ratio network to the circuit to produce a dual response characteristic. Although these requirements for band-pass filter and demodulator response characteristics seem severe, they are necessary to obtain good instantaneous correlation between personal impression of thump and meter reading.

In the meter that incorporates these features, a calibration level has been set such that components of 45 and 50 cps, each having sound pressure levels of 95 db, result in a reading of 10. (Paper "Tire Thump: Its Mechanism and Measurement" was presented at SAE Golden Anniversary Passenger Car, Body & Materials Meeting, Detroit, March 1, 1955. Complete paper appears in 1955 SAE Transactions. It is also available in full in multilith form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

At the Tractor Meeting in Milwaukee Sept. 12-15 . . .



New Machinery Presages New Era

The Earthmoving and Farm Equipment Industries Offer New Equipment that Will Shape the Future

GREAT changes are in the offing throughout the tractor industry. From the papers presented at the technical sessions and from the informal "bull sessions" that are characteristic of this annual tractor industry get-together, it was evident that a new era is dawning. The future will be marked by increased manufacturing and sales tempos, amazing new machinery, and more flexible management policies that can cope with a rapidly changing national economy.

Manufacturers who were traditionally cautious of too-rapid innovations are now jumping ahead with new designs and new production methods that will revolutionize farming and earthmoving practices throughout the world. They are pouring money and manpower into research and development as never before, trying to produce more powerful, more economical, easier-to-maintain equipment before their competitors do. Many have gone back to basic research and have restudied farming and earthmoving operations. As a result, new concepts and designs have been derived. There seems to be no limit to the size, power, and versatility of the new equipment being offered.

One reason for the rapid strides was pointed out by R. S. Stevenson, president of Allis-Chalmers, as he addressed the dinner Wednesday night.

He said that a new philosophy, which started with the atomic Manhattan project in 1942, will have as great an influence on industry as the concept of interchangeability of parts. At the Manhattan project "for the first time in history, on such a large scale, we went into mass production before the prototype had been built. Our scientists and engineers were confident of their calculations, $2,000,000,000 was appropri ted, and they were proved right." Thus we gained confidence that with sound calculations and expert laboratory techniques we can short-cut some of our old trial-and-error test methods. This concept is now being used in the electronics and advanced metallurgical fields, he said, and it will shortly sweep through all engineering in industry.

In the earthmoving field, he stated, our road-building machines are good, but they must be improved. Tomorrow's jobs will be too big for yesterday's machines and methods.

One manufacturer has developed a new crawler tractor which is powerful enough to push by itself the enormous scrapers and roadbuilding equipment

NEXT YEAR'S presidential nominee, G. A. Delaney, Pontiac Motor Division, GMC, is congratulated by 1955 president C. G. A. Rosen.

now being used in earthmoving jobs. It is powered by twin diesel engines and has an automatic quick-shift power transmission.

On the farm, the farmer will need improved equipment to help him cut his production costs and survive the current cost-price squeeze. By 1975 the increasing population will require faster, more productive farm equipment to take care of food needs.

Besides more powerful equipment, the farmer is looking for all the conveniences on his tractor that he is finding on his automobile: power steering, automatic transmission, simplified controls, and personal comfort. He also wants faster top speeds and better fuel economy. One technical paper presented at the tractor meeting described a new diesel tractor engine that was designed especially to cut fuel costs.

Since much of the farm and construction equipment is getting larger, there is urgent need for brakes that can handle these heavier loads. In the past, the ordinary two-shoe, fixed anchor brake was adequate for the 20,000-25,000 lb axle loads. The future will see axle load capacities up to 100,000 lb and speeds higher than ever before. Both multi-shoe brakes and disc brakes will be needed for these loads. Also, supplementary electric regenerative brakes and the use of torque converter mechanisms for braking are expected to play a large role in future earthmoving vehicles.

Engineers attending the sessions were informed of another important trend in the design of farm and construction machinery: Equipment is being designed for easy maintenance.

In recent years machinery has become much more complex and, therefore, much more difficult to operate and keep in good working condition. The armed forces, particularly, have found it difficult to train personnel to handle breakdowns quickly. The only way to solve this problem is to design desirable servicing features into the equipment from the start rather than try to modify existing equipment.

The SAE, through a CIMTC subcommittee, has been investigating this area with the purpose of recommending desirable ease-of-maintenance practices to the industry. The armed forces are including in their equipment specifications certain ease-of-maintenance features which will eventually become part of the basic design.

The Tractor Meeting also indicated that, in spite of general trends toward a faster-moving industry, there will still be plenty of interest in and time to take up the specific problems of small portions of the industry. For instance, a paper was presented which outlined a program for mechanizing the production of tobacco. Manufacturers are devoting a considerable part of their research to solving the peculiar problems of this unique farming operation. Also, they are aware that much of the farm lands brought under cultivation in the future will be on hillsides and in mountainous country. Most current combines were designed for broad flat mid-western plains. So, manufacturers are converting standard combines, or designing new self-propelled combines for use in rougher territory.

Truly, these new machines will shape the future.

Papers presented at the SAE Golden Anniversary Tractor Meeting are available in full from Special Publications Department. Price: (each) 35¢ to members, 60¢ to nonmembers. Abridgments of these papers will appear in future issues of the SAE Journal. Highlights of each of these papers follow.

1955 SAE Golden Anniversary Tractor Meeting Highlights

TRACTORS GET POWER SHIFTS—Power-shift transmission for farm tractors of the near future appears certain. In contrast, there appears to be no practical need for automatic gear shifting. Additional speed ratios are desired up to six or eight well-spaced speeds. Multi-speed power-take-off drives seem to be in the future, but there is only mild interest in the torque converter as part of the farm tractor transmission.—**C. A. Cook, Clark Equipment Co.**, "Transmissions, Today and Tomorrow"

NEW TRACTOR DIESEL—John Deere's model 70 diesel engine uses direct fuel injection. It has two cylinders with a bore of $6\frac{1}{8}$ in. and a stroke of $6\frac{3}{8}$ in. Rated engine speed is 1125 rpm. The engine develops approximately 50 observed belt hp. Specific fuel consumption is improved over other existing models. The engine is started by an auxiliary gasoline engine.—**B. G. Valentine and Russell Candee, John Deere Waterloo Tractor Works**, Deere Mfg. Co., "The John Deere Model 70 Tractor Diesel Engine"

SAFETY CLUTCH—A new safety clutch to protect PTO drives depends for its action on a torque spring. It is designed for a very small torsional spring rate which causes the axially movable clutch component to advance into clutch face contact by rotating with respect to a very fine pitch cam surface. Unfortunately the initial cost of this clutch is quite high.—**S. C. Heth, J. I. Case Co.**, "Development of Safety Clutch for Tractor PTO Drives"

MECHANIZING TOBACCO FARMING—The mechanization of tobacco farming has progressed faster during the last 10 years than in the previous 300

years, but there is still much to be done before a one- or two-man machine can automatically prime and handle tobacco for curing. Leaves must be picked up, preferably before coming in contact with the ground, and conveyed to a mechanism which will automatically arrange them for curing. An automatic looping device, or means of clamping the leaves to a continuous belt are possibilities.—**W. E. Splinter, and C. W. Suggs, Agriculture Engineering Department, North Carolina State College, and R. W. Wilson, R. H. Bouligny Co.**, "Mechanizing the Production of Tobacco"

TWIN DIESEL TRACTOR—Euclid's new twin diesel crawler tractor is made up of two tractor chassis which are hinge-mounted at approximately the center of gravity of each of the halves on a large cross shaft. Each tractor half contains a main frame, a gear box which houses the bevel gearing and mounts the transmission. It also mounts the drop gearing and final drive gearing for driving the sprocket and the roller frame and track system. The engine for each half is a Detroit Diesel 671 connected directly to a drive shaft into the torque converter.—**R. C. Williams, Euclid Division, H. C. Kirtland, Allison Division, and C. M. Jordan, Styling Section General Motors Corp.**, "Twin Power For Easy Mobility"

HEAVY-DUTY BRAKES—Both the conventional shoe and disc brake designs can be improved substantially to handle the braking requirements of heavier loads. The future will see not only electric regenerative brakes but the use of torque converter mechanisms which are now being accepted as a component of the propelling mechanism.—**R. K. Super, Timken-Detroit Axle Division, Rockwell Spring and Axle Co.**, "Heavy Duty Brakes For Earth Moving Vehicles"

VALVE LIFE LENGTHENED—By using alcohol-water injection in farm tractor engines burning white gasoline it was possible to prevent valve failure due to burning and sticking. However, the relatively small amount of injection of alcohol-water did not prolong valve life in tractors burning regular gasoline. The value of injection is that it enables the operator to use white gasoline in tractors of higher compression ratio.—**J. A. Weber, University of Illinois**, "Effects of Rotation and Alcohol-Water Injection on Farm Tractor Valve Life"

TORQUE CONVERTERS FOR TRACTORS—The excavating industry is becoming more and more aware of the advantages offered by torque converters, and there is an increasing demand for converters on excavators such as shovels, draglines, and dragshovels. The variety of converter types offered for excavator service is also on the increase.—**P. J. Swanson and J. H. Meier, Bucyrus-Erie Co.**, "Effect of Rapid Load Changes on Torque Converter Performance"

Industry "Brass" Come to Dinner

THIS YEAR'S Tractor Meeting and Production Forum dinner had an exceptionally large turn-out of the tractor industry's top management. Our cameras caught some of these men at the predinner reception. Others at the dinner but not shown in these photos were SAE Past-President **R. R. Teetor**, president of Perfect Circle Corp.; **R. S. Stevenson**, president of Allis-Chalmers Mfg. Co.; **C. J. Reese**, president of Continental Motor Corp.; and **J. E. De Long**, president of Waukesha Motor Co.

1. Left: A. W. Phelps, chairman of the board, The Oliver Corp.
Right: J. T. Brown, president, J. I. Case Co.

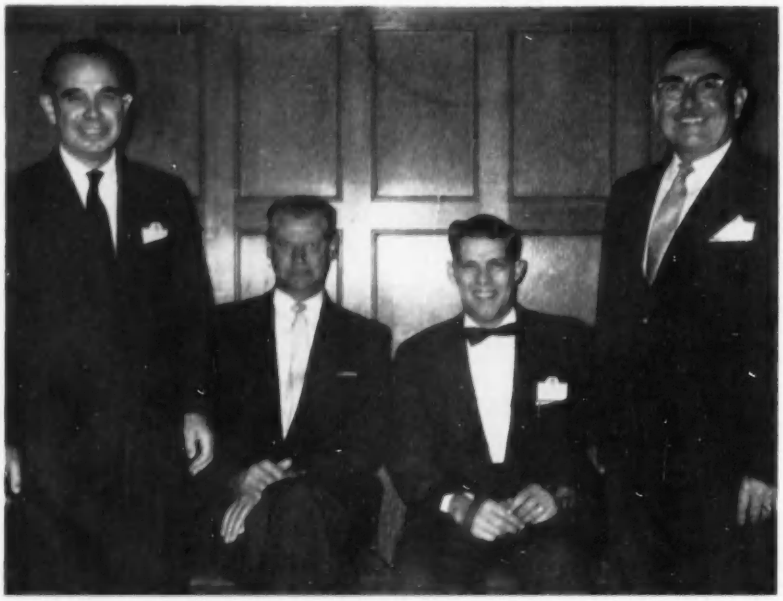
2. Left: H. S. Eberhard, president, Caterpillar Tractor Co.
Right: M. R. Yontz, president, LeTourneau-Westinghouse Co.

3. Left: D. S. Neuhart, general superintendent, Motive Power and Machinery Division, Union Pacific Railroad Co.

Center: C. G. A. Rosen, 1955 SAE president and consulting engineer to the president, Caterpillar Tractor Co.

Right: W. L. Litle, president, Bucyrus-Erie Co.

FARM ACCIDENTS DECREASING—Statistics show that farm accidents decreased 40% from 1944 to 1952 in Kansas, 30% from 1945 to 1952 in Wisconsin, 31% from 1946 to 1952 in Ohio, 20% from 1944 to 1952 in Minnesota, and 75% from 1950 to 1953 in New



BEHIND THE SCENES of the successful Golden Anniversary Tractor Meeting and Production Forum were (left to right) SAE Vice-President Trevor Davidson, (Tractor and Farm Machinery Activity) and his meetings vice-chairman, W. E. Swenson; SAE Vice-President P. A. Miller, (Production Activity) and his meetings vice-chairman, E. O. Wirth.

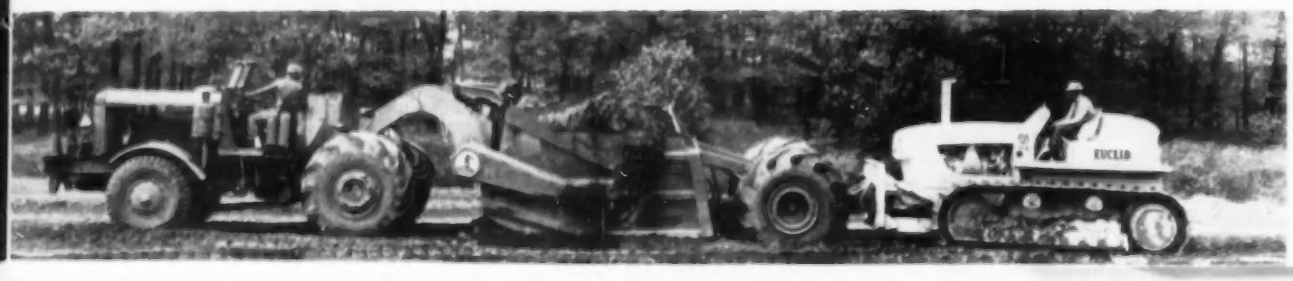
PRE-DINNER RECEPTION brought together (left to right) Igor Kamlukin, chairman of the Milwaukee Section; A. W. Van Hercke, chairman of the General Committee; R. S. Stevenson, president of Allis-Chalmers Manufacturing Co. and guest speaker for the dinner; and Dr. A. T. Colwell, toastmaster.

Hampshire. This safety record may have been helped by better and safer designs of farm machinery. To reduce accidents further we must teach the operators how to be more careful.—**Martin Ronning, Minneapolis-Moline Co.,** "Safer Design and Use of Farm Equipment"

HILLSIDE COMBINE—The self-propelled hillside combine is not as new as you think. On April 5, 1910, Benjamin Holt took out a U. S. patent covering one, and in 1912 several of these machines were built by the Holt Co. However, the farm economy of the west and northwest was not yet ready for this innovation. It wasn't until 1949 that modern industry built a self-propelled hillside combine.—**D. C. Heitshu, John Deere Harvester Works,** "The Self-propelled Hillside Combine"

EASIER MAINTENANCE SOUGHT—Modern construction machinery is getting more and more complicated and more difficult to maintain and service. The armed forces, one of the largest users of earth moving equipment, has started an investigation into what can be done to increase ease of maintenance. Initial studies indicate that desirable features should be designed into the equipment from the start rather than trying to modify existing equipment. It also appears that the slightly higher initial costs can be recouped by making assembly easier and by increased efficiency in the field.—**R. C. Navarin and K. H. Usow, Engineer Research and Development Laboratories, Corps of Engineers, U. S. Army, Fort Belvoir,** "Design and Ease of Maintenance"

TRACTOR TIRES A BOON—No other single change in the design of farm tractors has so improved their efficiency, increased their usefulness, and promoted their popularity as the advent of low-pressure pneumatic tires. This made possible the transition from animal to tractor power in many areas where steel tires and high drive wheel lugs were not acceptable. Rubber tires permitted higher working speeds and improved transportability, and encouraged new implement designs. They raised the over-all level of tractor performance and increased the volume of work which a tractor could do in a given time.—**F. C. Walters and W. H. Worthington, Engineering Research Division, John Deere Waterloo Tractor Works,** Deere Manufacturing Co., "Farm Tractors and Their Tires" (Reporting Progress of SAE Tractor Tire Committee)



Control . . . Cost . . . Quality

Time and again this three-part target came up as the focal point of discussions in the seven panel sessions at the Tractor Production Forum, on Monday, Sept. 12.

THE more than 550 manufacturing men and engineers who swapped experiences and problems at this day-long Production Forum were looking for answers to this one question:

> What kind of **CONTROLS** do we need to keep down the **COST** of manufacturing our products, without impairing **QUALITY?**

Answers offered were varied. But most fell into two main categories.

1. Keep striving for greater coordination between the design engineers and the manufacturing men so that the product will be producible with the facilities available, and at a reasonable price.

2. Concentrate on manufacturing research for development of new and better production methods, processes, and equipment.

Following are a few of the highlights of the discussion at the seven panel sessions. A complete report of all the seven panels will be available as SP-312 from the SAE Special Publications Department. Price: $1.50 to members, $3.00 to nonmembers.

NEW METHODS—Larger companies are setting up manufacturing research departments. The aim: lowered production costs. All companies are striving for greater coordination between methods, tool design, tool room, production, and design engineering departments through committees.

There's still no satisfactory formula for economical machine tool replacement. The MAPI formula is no longer adequate, without modifying it to take current problems into consideration. **Tool Design, Tool Room, Methods Engineering—Their Relationship to Manufacturing**

GEAR FABRICATION—Gear specialists are on the hunt for better control of materials and processes to improve quality and cut costs. They see quality gains accruing from induction hardening, shot peening, and hot salt quenching.

Higher cutting speeds are seen for the future as machines are introduced that can stand the gaff. It was cautioned that in hobbing cast iron, speeds should be cut and feed increased to prevent burning the tool. But before you go off on a limb on any speed-feed combination, make tests to come up with the optimum for the material you're cutting.—**Essential Factors in Manufacturing Gears and Heat-Treating Techniques**

INDIRECT COSTS—Reduction of

PRODUCTION FORUM sponsor J. E. DeLong (left), president of Waukesha Motor Co., talks over the day's activities with the Forum's general chairman A. A. Herzberg, Waukesha's plant manager.

LOOKING OVER PROGRAM of the Tractor Production Forum are general chairman A. A. Herzberg and the seven panel leaders. (Left to right standing) Chauncey Hart, The Heil Co.; E. J. Oakley, Delco Remy Division, GMC; W. C. Cheney, Gillett-Eaton, Inc.; Dr. M. Gordon, Marquette University; B. C. Bugbee, The Falk Corp. (Left to right seated) B. W. Keese, Wisconsin Axle Division, Rockwell Spring and Axle Co.; A. A. Herzberg, Waukesha Motor Co.; C. E. Pflug, American Motors Corp.

costs will come from evaluation of indirect costs, setting standards, and application of job evaluation. IBM equipment also will reduce the expense of record keeping.—**Methods of Controlling Indirect Manufacturing Costs**

MANUFACTURING EXECUTIVES—Job skills and knowledge are less important criteria in selecting executives than other attributes.

Ten key qualities to look for in a good executive are: (1) intelligent, understands technical aspects of the job, (2) well adjusted, doesn't blow up in a crisis, (3) big enough to avoid petty arguments, (4) furnishes a calm, stable atmosphere within his organization, (5) physically able to withstand the rigors of the job, (6) sufficiently motivated to put time and energy into his job, (7) stimulates and leads people around him, (8) interacts well with people, even those over whom he has no authority, (9) organizes well instead of playing it by ear, and (10) communicates well, tells people what he has in mind and how he wants to achieve his operational objectives.—**Are We Properly Evaluating Future Supervisors and Specialists?**

QUALITY CONTROL—There's an increasing trend toward checking machine tools in the builder's plant before they're accepted by the customer. In fact, many purchase agreements have a clause requiring the machine to meet specifications. That's one way to insure the degree of quality in the parts to be fabricated on the machine. —**Quality Control and Its Relation to Production and Engineering**

PRODUCTION CONTROL—More and more companies are relying on production control departments to give facts about manufacturing operations.

Inventory control is still a significant problem. Today most companies are eager to build up inventories. A few months ago the emphasis was on cutting them.—**Production Control and Its Effect on Manufacturing**

WELDING ADVANCES—Much progress is being made with consumable electrode welding. In recent months especially, carbon dioxide has come into the picture.

Semi-automatic and completely automatic welding processes are also becoming more attractive as manufacturers search for ways of cutting costs.—**The Future of Welding**

About SAE Members

Nance

Churchill

Burks

Davies

Sasso

Warner

Thomiszer

DeSmet

Johnson

Gagg

MacKinney

Swan

JOHN SASSO, vice-president of G. M. Basford Co., has been elected to the company's board of directors. Basford handles advertising, marketing, and public relations for more than 70 companies and associations. Sasso is in charge of public relations and publicity.

HAROLD G. WARNER has been appointed works manager of the Cadillac Motor Car Division, General Motors Corp., Detroit, Mich. He had been assistant works manager. Warner joined the Cadillac organization in 1927.

HUBERT J. THOMISZER has been appointed manager of the Magnilastic Division, Cook Electric Co., Chicago, Ill. He was previously project engineer at Cook Research Laboratories.

E. C. DeSMET has become executive engineer on the executive staff of Willys Motors, Inc., Toledo. He had been director of body engineering.

G. LAWTON JOHNSON has been elected president of Greer Marine Corp., wholly-owned subsidiary of Greer Hydraulics, Inc., Jamaica, L. I., N. Y. **EDWARD M. GREER**, president of Greer Hydraulics, has been named chairman of the board of Greer Marine.

Mr. Johnson is a vice-president of Greer Hydraulics and will continue in that capacity, in addition to heading the subsidiary firm. He is also senior director of the foreign operations wholly owned by Greer Marine Corp., which include Greer Marine, Ltd., England; Deutsch-Greer Marine, G.M.B.H., Germany; and Greer Marine Cie., France.

JAMES J. NANCE, president, Studebaker-Packard Corp., has announced his company will not operate with all Packard and Clipper automotive operations consolidated into a Packard-Clipper division and with Studebaker car and truck operations in a Studebaker division. Managers of each division will administer their respective divisions as separate operating organizations in accordance with corporate policies and programs and provide coordination between divisional operations, corporate departments, and staffs.

HAROLD E. CHURCHILL has been named manager of the Studebaker division of the Studebaker-Packard Corp. Churchill is an SAE past vice-president for Passenger Car Activity and, for several years, was chairman of the Society's Meetings Committee. Manager of the Packard-Clipper division is Robert P. Laughna.

G. E. BURKS has been elected a vice-president of Caterpillar Tractor Co., Peoria, Ill. In his new position he will continue to give administrative direction to the company's research department and the engineering departments at four plants. Burks has been with Caterpillar for 26 years. His latest position was director of engineering and research for Caterpillar.

J. M. DAVIES, has been named an assistant to **G. E. BURKS** at Caterpillar Tractor Co. 1940 SAE vice-president representing Tractor & Industrial Engineering, Davies has been Caterpillar's director of research for a number of years. In his new position, Davies will make his headquarters at Caterpillar's new San Francisco, Calif., plant. He will spend much of his time in the field observing performance of earthmoving and power equipment.

RUDOLPH F. GAGG has been named group-executive-staff engineer for the eastern divisions of Bendix Aviation Corp. Gagg, who resigned from Bendix in 1954 to become special aide in the office of the Assistant Secretary of the Air Force, will be responsible for staff administration of engineering, and research and development work of the following divisions: Eclipse-Pioneer, Teterboro, N. J.; Scinetilla, Sidney, N. Y.; Utica, Utica, N. Y.; Red Bank, Eatontown, N. J.; Pioneer-Central, Davenport, Iowa; and Friez Instrument, Baltimore, Md.

GORDON W. MacKINNEY has been promoted to assistant to the general manager, contract and order department, Propeller Division, Curtiss-Wright Corp., Caldwell, N. J. He had been manager of the department.

ROBERT SWAN, previously with Aero-Coupling Corp. in Berkeley, Calif., as industrial sales engineer, is now with Hall-Scott Motors Co. in Berkeley.

R. E. BRADLEY has been appointed executive sales engineer, Bendix Products Division, Bendix Aviation Corp., South Bend, Ind. Bradley has been associated with the Bendix Automotive Engineering organization in various capacities for the past 14 years. Since 1952 he has been engaged in customer contact engineering work.

WALTER TREFZ has joined Micro Lube Sales, Dallas, Tex., as technical service director. He will work with maintenance engineers and technicians in the powerplant, transportation, and automotive industries. Also, he will assist all users of internal combustion engines with problems of lubrication. Trefz was formerly service engineer for Aluminum Industries.

ALVA L. DORRELL has joined Citizen's Transportation Co., Riverside, Calif., as superintendent of equipment maintenance. He had been automotive engineer, maintenance, for General Electric Co., Richland, Wash.

MICHAEL PINTO, president, Pioneer Engineering & Mfg. Co., Inc., Detroit, has announced the formation of a new division devoted exclusively to body engineering. The division will be located in Pioneer's Goldner Division, and will provide complete body engineering services from artists' renderings to production drafts and details. It will also contract for and supervise the construction of scale and full-size models.

JOHN J. HOSPERS, assistant to the general manager, Chance Vought Aircraft, Inc., Dallas, has been named chairman of the newly-organized Aviation Council of Texas. The council will coordinate the efforts of the aviation industry and all aviation associations in Texas to promote and develop aviation in Texas.

L. L. COLBERT, president of Chrysler Corp., Detroit, who served as 1955 chairman of the Special Gifts Committee of the National Conference of Christians and Jews, will continue in the same capacity in 1956. He will lead a country-wide effort to raise funds to help finance the Conference's program for building good will and understanding among Protestants, Catholics, and Jews.

Wells | Vance | Paulbach | Gates

EDWARD H. WELLS is now merchandise manager of the new Packings and Friction Materials Division, Johns-Manville Corp. Wells was assistant to the merchandise manager of the Industrial Products Division, which has been split into three new operating divisions: the Packings and Friction Materials Division, Industrial Insulations Division, and Pipe Division.

HAROLD S. VANCE, chairman of the executive committee of the Studebaker-Packard Corp., was appointed by President Eisenhower to the Atomic Energy Commission. His term will run through June 30, 1960, provided his appointment is approved by Congress when it reconvenes in January.

Vance was president and chairman of the board of the Studebaker Corp. from 1935 to 1953, and has been with Studebaker since 1911. Since 1953 he has served as a special consultant to the director of the Office of Defense Mobilization.

During his 44 years connection with the Studebaker Corp. Vance has held various positions. He started as a mechanic and advanced steadily up the ladder to assistant treasurer, assistant to the president, vice-president in charge of manufacturing and engineering, and in 1935, chairman of the board of directors.

Early in 1948, when Paul Hoffman left Studebaker to head the ECA, Vance succeeded as president. Last year, when Studebaker merged with Packard Corp., he became chairman of the executive committee of the new corporation.

R. A. PAULBACH, has been appointed to the sales management staff of the Western Division of Resistoflex Corp., Belleville, N. J. Formerly with the Aeroquip Corp., Paulbach will make his headquarters at the company offices in Burbank, Calif.

JOHN B. GATES, formerly manager, Commercial Pump Division, Thompson Products, Inc., Cleveland, has been named manager of the Bell, Calif., plant of Thompson. He has served in various sales and managerial capacities with the company's manufacturing divisions in Ohio and Michigan since 1943.

ABRAHAM ZUKERMAN, formerly teaching fellow at St. Louis University, St. Louis, Mo., is now teaching assistant at the University of Southern California, Los Angeles. He is in the mathematics department.

JOSEPH H. STALEY, president, Staley Mfg. Corp., and the Electric Switch Corp., Columbus, Ind., is now retired and living in Fort Myers, Fla.

RICHARD Y. CASE, assistant manager and chief engineer, power transmission department, United States Rubber Co., was awarded the Edward Longstreth Medal of the Franklin Institute at the Institute's Annual Medal Day ceremonies, October 19.

He was cited "In consideration of his invention of the 'timing belt,' a rubber and fabric belt with teeth that makes engagement with axially grooved pulleys, producing a completely positive drive that does not depend upon frictional grip for the transmission of power, and makes possible precision timing between two or more shafts."

GABRIEL M. GIANNINI, president, G. M. Giannini & Co., Inc., has announced that the Airborne Instrument Division of the company, Pasadena, Calif., has been organized into three separate airborne operations divisions —the new Gyro, Systems, and Transducer Divisions.

L. L. COLBERT, president, Chrysler Corp., has announced purchase by Chrysler of the Universal Products Co. and its wholly owned subsidiary, Formetal Co.

DAVID BLATTNER is with the Boeing Airplane Co., Seattle, Wash., as a designer. Prior to joining Boeing he was with the Syracuse Supply Co., Construction Division, Syracuse, N. Y., as sales engineer.

HERBERT D. ANTON, formerly a research engineer with Shell Oil Co., Wood River, Ill., has joined the engineering staff of West Bend Aluminum Co. at the outboard engine plant in Hartford, Wis. He is a development engineer on outboard engines.

GLEN R. WALTERS has joined Boeing Airplane Co.'s training devices group as an engineer designer. He had been sales-service representative for E. I. duPont de Nemours & Co., Petroleum Chemicals Division, Atlanta, Ga.

RICHARD W. HOYT, formerly vice-president and chief engineer, Double Seal Ring Co., Fort Worth, Tex., has joined C. Lee Cook Co., Louisville, Ky., as assistant to the president. He heads a newly-organized department to handle and develop all special rings and special applications of standard rings, such as hydraulic rings. Hoyt is a past secretary and vice-chairman of the Texas Section.

ROBERT J. WHITLA, previously account executive, Ruthrauff & Ryan, Inc., Toronto, Ont., Can., has joined Grant Advertising (of Canada), Ltd., Toronto, as account executive.

ROBERT A. SHOGREN, formerly oilfield engineer for Allis-Chalmers Mfg. Co.'s Buda Division, Harvey, Ill., has become sales engineer for the Oildex Corp., Tulsa, Okla.

JAY W. ATMAN is now assistant product manager, electrical, Aluminum Co. of America. He had been sales engineer for the company.

DONALD D. KRIPLEN, formerly with Auto Imports, Ltd., Indianapolis, Ind., as service manager, is now process engineer, Allison Division, General Motors Corp., Indianapolis.

R. ARTHUR GAISER has joined Ball Brothers Co., Inc., Muncie, Ind., as director of research and product development. Gaiser was previously with Libbey Owens Ford Glass Co., Toledo, Ohio, as associate director of research.

CLAUDE F. WALDRON, previously assistant section engineer, American Bosch Division, American Bosch Arma Corp., Springfield, Mass., is now chief engineer, American Bosch Arma Mississippi Corp., Columbus, Miss.

THOMAS E. MOORE recently became experimental engineer for the Aircraft Division of Eaton Mfg. Co., Battle Creek, Mich. He had been technical engineer, Aircraft Gas Turbine Division, General Electric Co., Evendale, Ohio.

HOWARD E. CHANA has returned to civilian life from two years service with the U. S. Army. While in the Army he was stationed at Aberdeen Proving Grounds, Md., where he worked as a project engineer on medium class military vehicles. He is now with Buick Motor Division, General Motors Corp., Flint, Mich., in the company's engineering training program.

HARRY M. WILLIS has joined Modern Die and Tool Corp., Los Angeles, as chief inspector. Previously he had been chief inspector, Kilgore, Inc., Westerville, Ohio.

GEORGE KELLER, JR. is now with the Kearfott Co., Inc. of Little Falls, N. J. He had been engineering division manager, Wright Aeronautical Division, Curtiss-Wright Corp., Wood-Ridge, N. J.

SAMUEL D. GRECO recently joined the staff at the Ordnance Research Laboratory, The Pennsylvania State University, University Park, Pa. He had been rocket test engineer, Bell Aircraft Corp., Rocket Division, Buffalo, N. Y.

SAE Father and Sons

FLOYD F. KISHLINE, American Motors chief engineer at Kenosha, heads one of the largest of SAE Fathers-and-Sons delegations. Left to right:

ALAN R.; **FLOYD F.**; **SAMUEL J.**; and **FLOYD R.**

Delegation head Floyd F. is a past vice-president of SAE for Passenger Car Activity, while SAE Enrolled Student Samuel J. was chairman of the SAE Student Branch last year at Purdue University. Alan R., graduate of the University of Wisconsin, is in Engineering at American Motors in Kenosha; Floyd R., assistant development engineer at the same place and secretary of the Purdue University Student Branch prior to graduating there.

JOHN P. GATY, vice-president and general manager of the Beech Aircraft Corp., Wichita, Kans., has been awarded the 1954 Business Flight Safety Trophy. The annual award was presented by the Women's Aeronautical Association of Kansas in recognition of his contributions advancing business flying safety.

The silver trophy was presented to Gaty last month during a dinner meeting opening the three-day Eighth Annual Meeting and Forum of the National Business Aircraft Association. This meeting was held in Detroit.

WALTER H. NOFFKE is now with Lockheed Aircraft Corp., California Division, Burbank, Calif., as manufacturing research engineer. He had been with Boeing Airplane Co., Seattle, Wash., as project engineer, manufacturing research.

C. F. DERBYSHIRE, former mechanical design specialist, Rohr Aircraft Corp., Chula Vista, Calif., is now chief mechanical engineer, Pacific Coast Division of A. O. Smith Corp., Los Angeles, Calif.

LEO J. SHANNON has been appointed service manager of Chandler-Evans, Division of Niles Bement Pond Co., in charge of service engineering. Shannon has been associated with Chandler-Evans since 1944 in various capacities. **LOUIS G. BURNS**, former chief pump engineer, Chandler-Evans, has been appointed sales manager of the division.

JOHN G. LIPPERT has joined A. E. Friedgen, Inc., transportation consulting engineers, New York, N. Y. He had been automotive engineer, Cab Service & Parts Corp., subsidiary of Checker Cab Corp., New York, N. Y.

EVERT B. HURST is now employed as a project engineer in the Body Structures Laboratory of the Highland Park, Mich., plant of Chrysler Corp. He had been instructor, product engineering department, General Motors Institute, Flint, Mich.

HARVEY S. FIRESTONE, JR., chairman and chief executive of The Firestone Tire & Rubber Co., has been named national chairman of Brotherhood Week, to be observed next February 19–26, sponsored by the National Conference of Christians and Jews.

RAYMOND C. FIRESTONE, executive vice-president of The Firestone Tire & Rubber Co., was among the nation's business and industrial leaders who met recently at the national headquarters of the Future Farmers of America in Washington, D. C., to judge winners of the 1955 Star Farmer of America awards.

S. H. KNIGHT is now fleet manager for Northern Pacific Railway Co., St. Paul, Minn. He was formerly supervisor of work equipment for the company in St. Paul. Mr. Knight was an SAE Journal field editor for the Twin Cities Section.

FRANK G. WOOLLARD, consulting engineer, Birmingham, England, is the author of a new book, "Principles of Mass and Flow Production," Philosophical Library, New York, N. Y. The book covers: history of flow production; range of applications; the principles; a general survey; launching a new product; specialization, standardization, simplification; raw material requirements; achieving continuous operation; time planning; accuracy of workmanship; long-term planning; maintenance; transfer machines and automation; cost-keeping; automatic transfer machines; the automatic factory, human relations.

COL. WILLARD F. ROCKWELL, chairman of the board of Rockwell Mfg. Co. and Rockwell Spring and Axle Co., will assist in preparing a study on "Business Executives in the Federal Government," a project sponsored by the Harvard Business School Club of Washington, D. C. Rockwell's appointment to the national advisory board for the project is one of 40 business appointees in and out of government representing the widest possible geographical area. Colonel Rockwell, a former assistant to the Secretary of Defense, will represent the Pittsburgh area. The study will attempt to analyze and recommend solutions to the problems of getting and retaining good executives to help operate the federal government.

ANDREW L. POMEROY, associate director, staff research and development, Thompson Products, Inc., has been given direction of the company's new Nuclear Products Department. Pomeroy was recently made adviser to the president of SAE on the potential relationships of nuclear developments to the Society. He is also the nominee for 1956 SAE vice-president for Aircraft Powerplant Activity.

Hall L. Hibbard (left), vice-president, engineering, Lockheed Aircraft Corp., Burbank, Calif., and **Edward S. Fife**, Lockheed director of commercial sales for Europe, Africa and the Middle East, are shown at Lake Alister in Hamburg, Germany. Both Hibbard and Fife are SAE members. This picture was taken following their inspection of the new Deutsch Lufthansa maintenance facilities in Hamburg.

EDWIN B. WATSON, associate professor of mechanical engineering at Cornell University, Ithaca, N. Y., was lecturer for a two-day Fuels and Combustion Short Course at Oklahoma Agricultural and Mechanical College, October 24–25. Watson lectured on Physical and Chemical Properties of Solid, Liquid and Gaseous Fuels; Chemistry of the Combustion Reaction; Thermodynamics of the Combustion Reaction; Basic Combustion Phenomena; Combustion Processes in Engines; Combustion in Gas Turbines, Rockets, Etc., and Industrial Fuel Burning.

WILLIAM P. LEAR, board chairman of Lear, Inc., Santa Monica, Calif., has been elected to membership in Tau Beta Pi, national engineering honorary society, by Alpha chapter at Michigan State College, in recognition of his "outstanding record of achievement and integrity in the engineering profession."

LEONARD ZICK, president, Allen Electric and Equipment Co., Kalamazoo, Mich., is serving on an advisory committee working with the industrial supervision curriculum at Western Michigan College, Kalamazoo.

FREDERICK B. LEE, Federal Civil Aeronautics Administrator, was principal speaker at the National Business Aircraft Association's annual awards luncheon. His subject was "CAA Meets the Challenge of Expanding Aviation."

CHARLES F. KETTERING, director and research consultant, Research Laboratories Division, General Motors Corp., was principal speaker at a special luncheon held by the association, October 6. He spoke on future developments in the business flying field.

JOHN E. CONNOLLY is president of Super Alloy Forge, Inc. in Hamburg, Mich. He has been operating the firm for a little over a year now, specializing in hard-to-forge heat-resistant and chemical-resistant metals. His firm makes diesel valves, aircraft seat ejector components, and small parts used to complete chemical vats—as well as performing experimental work on close-tolerance forgings for other forge shops.

STANLEY C. PACE, formerly manager of the West Coast Division of Thompson Products, Inc., has been transferred back to Cleveland, Ohio, to become general manager of Thompson's Jet Division.

FULTON R. MAGILL, standards administration engineer, Rockwell Mfg. Co., Power Tool Division, Pittsburgh, Pa., has been elected chairman of the Pittsburgh Section of the Standards Engineers Society for 1956.

R. D. HENDERSON, previously manager of engineering development at Caterpillar Tractor Co., has been named an assistant director of research for the company. He will be in charge of the research program on engines.

PETER F. HURST, president Aeroquip Corp., Jackson, Mich., has been appointed to the General Management Planning Council of the American Management Association. The council plans conferences, seminars and other activities in the General Management Division of the association.

ABRAM vanderZEE, vice-president, Chrysler Corp., Detroit, has been re-elected chairman of the Inter-Industry Highway Safety Committee.

HELMUTH G. BRAENDEL, director of engineering and production for Wilkening Mfg. Co., Philadelphia, was a member of the faculty of Rutgers, University, New Brunswick, N. J., during a recent special 5-day course on preventive maintenance for motor fleet supervisors. He handled the subject of piston rings, pistons, sleeves and cylinders.

continued on p. 108

Obituaries

WILLIAM D. PIDD

William D. Pidd, specifications engineer, Chevrolet Motor Division, General Motors Corp., National Fleet Department, died recently.

Pidd had been part of the Chevrolet organization since 1921, when he entered industry. During this term of service, he was at one time or another associated with the Flint, Mich., Janesville, Wis., Indianapolis, Ind., Buffalo, N. Y., Syracuse, N. Y., Pittsburgh, Pa., and Detroit, Mich. Chevrolet offices and divisions.

WINSLOW BYRON POPE

Winslow B. Pope, 49, product engineer in the Wheel Division of The Budd Co., Detroit, died of a heart attack on Sept. 18, and was buried in Cleveland.

His activities have been in the engineering branch of the automobile industry since his graduation. He was with the engineering staffs of Stutz Automobile Co., Jordan Motor Co., and White Motor Co. before joining The Budd Co., where he has worked for 25 years.

While with Budd, Pope had served as Company Representative for the Tire & Rim Association and the Society of Automotive Engineers.

Pope was born in Cleveland, Ohio. He received his degree in Mechanical Engineering from Ohio Northern University.

B. H. McMILLAN

B. H. McMillan, zone fleet manager, Chevrolet Motor Division, General Motors Corp., Birmingham, Ala., died May 31. He was 49.

He had been zone fleet manager since 1947. In this position he contacted officials, superintendents of equipment and fleet engineers of companies holding General Motors' fleet user agreement regarding specifications, service and sales of Chevrolet automotive equipment. Prior to that he was with Chevrolet in Louisville, Ky., as zone commercial car and truck manager; and prior to that in Atlanta, Ga., as a division manager.

ADRIAN HUGHES, JR.

Adrian Hughes, Jr., senior engineer, transportation, J. G. White Engineering Corp., Department of Reports & Appraisals, New York, died May 2. He was returning from Indonesia where he had been doing a traffic and transit report for the Indonesian government.

Hughes was born January 24, 1890, at Baltimore, Md. He obtained an A.B. degree from Rock Hill College, Md. in 1908 and an M.E. degree from Cornell University in 1912. After graduation, he joined the Edgar Thompson Steel Mills, Carnegie Steel Co., as general foreman in the electrical department. He later spent many years with the United Railways & Electric Co., Baltimore, in supervisory positions.

He had completed more than 25 years of active membership in SAE and also had been a member of the American Society of Mechanical Engineers.

DONALD SMITH DEVOR

Donald Smith Devor, retired vice-president and director of the Houdaille-Hershey Corp., Detroit, died recently. He was 67.

Devor had been a member of SAE for 35 years (since 1920). At the time he became a member he was works manager at the Elizabeth, N. J. plant of Willys Corp. He previously had been employed at the Oldsmobile Motor Works, Lansing, Mich., as production manager.

He attended Pennsylvania State College, from which he received a B.S. degree in 1909.

JOHN CLIFFORD POPE

John Clifford Pope, 55, manager of the Gasoline Testing Division of Ethyl Corp., died suddenly August 11.

Mr. Pope obtained an M.S. degree from the University of Bristol, England, in 1921. Afterwards he attended the University of Upsala, Sweden, and the Massachusetts Institute of Technology, Cambridge. In 1926, he joined the Ethyl Corp. in Yonkers, N. Y., as a research chemist. He later worked for the company in Detroit, and at the time of his death was located in New York City.

Besides SAE, he was a member of the American Chemical Society.

WILLIAM FISHER JENNINGS

William Fisher Jennings, president and treasurer of the Bound Brook Oilless Bearing Co., Bound Brook, N. J., died September 14. He had been associated with the Bound Brook firm for 41 years.

During his term as president, Bound Brook quadrupled in sales and plant size. He was instrumental in finding new markets for powder metallurgy products, principally in the automotive, business machine, and home appliance fields. He gained recognition in the early days of automobile production, and later during World War II and the Korean conflict, by devising applications of the manufacturing process for use in cars and war material.

Jennings joined the company in 1914, was named Eastern sales manager in 1917, vice-president in 1919, treasurer and general manager in 1923, and attained the presidency in 1928.

He was a member of the National Association of Manufacturers and The New Jersey State Chamber of Commerce, besides SAE.

Guggenheim Medal . . .

. . . for 1955 will go to Theodore von Karman "for notable achievement in the advancement of aeronautics." The award will be made by ASME on Nov. 17, in Chicago.

A WORLD-FAMOUS aerodynamacist, Theodore von Karman, has been named the 1955 recipient of the Daniel Guggenheim Medal "for notable achievement in the advancement of aeronautics," according to an announcement by the Guggenheim Board of Award, comprised of members of The American Society of Mechanical Engineers, Society of Automotive Engineers, and Institute of Aeronautical Sciences.

Famous Aero Scientist

Dr. von Karman is presently chairman of the Advisory Group for Aeronautical Research and Development at NATO headquarters in Paris. The award will be made at ASME's Honors Luncheon in Chicago on Nov. 17 during the Society's Diamond Jubilee Annual Meeting celebration. Dr. von Karman is expected to name a substitute to accept the award for him, because he is currently abroad on his NATO work.

In 1910 he became professor of aeronautics and director of the Aeronautical Institute of the University of Aachen. He went to California Institute of Technology as professor of aeronautics in 1930, director of its Guggenheim Aeronautical Laboratory, and chairman of the Graduate School of Aeronautics. In 1941 he and four other scientists formed the Aerojet Engineering Corp., which has since grown into one of the most important rocket manufacturing companies in the country. During World War II he was appointed chairman of the Scientific Advisory Board of the U. S. Air Force and also acted as consultant for both the Army and Navy. He was awarded the Presidential Medal for Merit, the highest civilian award in the U. S., in recognition of his work during the war.

He is best known for his theories of the vortex motion and turbulence in fluids and for his work in supersonic aerodynamics. He received his master of engineering degree from the Royal Technical University of Budapest and his doctorate from the University of Goettingen, Germany.

You'll Be Interested to Know that . . .

COUNCIL CONFIRMED THE APPOINTMENT by Vice-President Paul Miller of Carl W. Goldbeck, Thompson Products, Inc., to the Production Activity Committee.

*

THE PRESENTATION BY SAE PRESIDENT C. G. A. ROSEN of the 1955 L. Ray Buckendale Lecture, scheduled for the November 15 meeting of the SAE Chicago Section, has been postponed.

*

SAE-NOMINATED CRC board directors for the 1955–56 term are E. N. COLE, G. J. HUEBNER, JR., ARTHUR NUTT, and F. W. FINK.

SAE members on the board who still have one year to serve are: L. L. BOWER, W. G. LUNDQUIST, and E. S. MacPHERSON.

1956 SAE National Meetings . . .

January 9-13
Annual Meeting
The Sheraton-Cadillac Hotel
and Hotel Statler, Detroit

March 6-8
Passenger Car, Body,
and Materials Meeting
Hotel Statler
Detroit

March 19-21
National Production Meeting
and Forum
Hotel Statler, Cleveland

April 9-12
Aeronautic Meeting,
Aeronautic Production Forum,
and Aircraft Engineering Display
Hotel Statler, New York

June 3-8
Summer Meeting
Chalfonte-Haddon Hall
Atlantic City, N. J.

August 6-8
West Coast Meeting
Mark Hopkins Hotel,
San Francisco

September 10-13
Tractor Meeting and
Production Forum
Hotel Schroeder, Milwaukee

October 2-6
Aeronautic Meeting, Aircraft
Production Forum, and Aircraft
Engineering Display
Hotel Statler, Los Angeles

November 1-2
Diesel Engine
The Drake, Chicago

Wentworth . . .

. . . is 1955 winner of the Russell S. Springer Award.

JOSEPH T. WENTWORTH (J '54), a research engineer in the fuels and lubricants department of the Research Laboratories Division of General Motors, is the 1955 winner of the Russell S. Springer Award.

Joseph T. Wentworth, 1955 winner of the Russell S. Springer Award.

The Springer Award is presented each year "to the youngest SAE member whose paper is published in SAE Transactions in the year for which the award is made."

Subject was Combustion

Wentworth is coauthor, with W. A. Daniel, of the paper, "Flame Photographs of Light-Load Combustion Point the Way to Reduction of Hydrocarbons in Exhaust Gas," which was presented at the Symposium on Air Pollution, held during the SAE Golden Anniversary Meeting, Detroit, Jan. 10, 1955. The complete paper is published on pp. 602–617 of the 1955 SAE Transactions, along with the other papers of the Symposium.

The Springer Award, established by the SAE Council in 1954, grew out of a $5000 bequest to the Society by the late Russell S. Springer. As winner of the Award, Wentworth received $100 and a certificate.

Mickle . . .

. . . '55 Beecroft Memorial Lecturer.

D. Grant Mickle

D. GRANT MICKLE, director of the Automotive Safety Foundation's Traffic Engineering Division, presented the 1955 SAE Beecroft Memorial Lecture on October 17 at the National Safety Congress in Chicago.

Mickle was named to receive the award in recognition of substantial contributions to motor vehicle traffic safety. Complete text of his address appears in the October SAE Journal, beginning on page 64.

J. N. Bauman, chairman of the Beecroft Award Committee and vice-president of White Motor Co., presented the Award certificate and a check for the $250 which the Award entails.

Sperry Award Goes to William Francis Gibbs

THE ELMER A. SPERRY Board of Award, on which the Society of Automotive Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the Society of Naval Architects and Marine Engineers are represented, has selected William Francis Gibbs, New York naval architect and marine engineer, as the first recipient of the Sperry Award. The presentation will be made in Chicago, Nov. 17, during the Diamond Jubilee Meeting of ASME.

The Award recognizes distinguished engineering contributions which through actual service, have advanced the art of transportation by land, sea, or air. It honors Mr. Gibbs for designing and supervising the construction of many ships and, specifically, for the SS United States. This 30-knot vessel, which has brought the transatlantic speed ribbon back to America, incorporates new ship design concepts, techniques, and uses of materials. It is regarded as the most advanced example of current engineering progress in the field of transportation.

Sperry Held More than 400 Patents

The Sperry Award commemorates the life and achievements of the late Dr. Elmer A. Sperry, whose wide range of inventions and more than 400 patents included coal-mining machines, electric vehicles, high-intensity lights, industrial processes, and numerous gyroscopic devices now used on ships and aircraft. The award has been established by Dr. Sperry's daughter, Mrs. Robert Brooke Lea, and his son, Elmer, Jr.

The Board is empowered to present the Sperry Award annually to individuals or groups of any nationality who may be nominated for outstanding individual or group work. SAE member R. B. Lea is chairman. Dr. Sperry was 48th president of ASME, a founder of AIEE, and member of both SAE and SNAME. Each year the award will be presented by the appropriate society.

Technical Committee Progress

Thomson Presents Hardenability Data On Carburizing Steels to ISTC Div. XXXIII

EVALUATIONS of hardenability at various carbon levels in a number of carburizing steels were presented by R. F. Thomson to Division XXXIII —Gear Metallurgy of the SAE Iron and Steel Technical Committee at a recent meeting.

Thomson is head of the Metallurgical Department of the Research Laboratories Division of General Motors. His graphs appear on the next page.

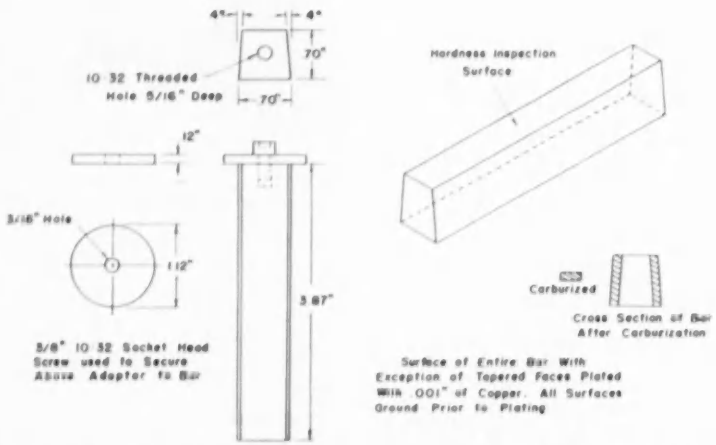

4"
4"
70°
10-32 Threaded Hole 5/16" Deep
.70"
.12"
3/16" Hole
1.12"
3.87"
5/8" 10-32 Socket Head Screw used to Secure Above Adaptor to Bar
Hardness Inspection Surface
Carburized
Cross Section of Bar After Carburization
Surface of Entire Bar With Exception of Tapered Faces Plated With .001" of Copper. All Surfaces Ground Prior to Plating

Fig. 1—A trapezoidal end-quench bar is used for measuring the hardenability of carburized steels.

His data were obtained on the trapezoidal bar shown in Fig. 1. This is used in an end-quenched hardenability test, so that the desired range of cooling rates is obtained. This end-quench bar, however, is of a modified design to permit accurate hardness measurements at various carbon levels of the case or in the core without the necessity of grinding to the desired level. The modified bar is similar in overall section size to the standard end-quench bar, but is of trapezoidal cross-section.

As indicated in the figure, the bar is first copper plated. The plate is then ground off the tapered faces and the bar is carburized and end quenched. The presence of the copper plate on the parallel sides of the bar restricts the case to the tapered faces. After quenching, the copper is ground from the top face of the bar to expose the case and core. Hardness measurements are then made at various depths below the tapered surfaces, along the length of the bar to obtain the hardenability curve at any desired level of carbon content.

Since the hardness impressions are made perpendicular to the direction of the carbon gradient in the case, each impression spans a portion of the carbon gradient. The hardness impression, therefore, should be small to minimize this effect, Thomson said. For this reason, a microhardness test (for example, diamond pyramid indentor with 3-kg load) is recommended rather than the Rockwell C test used in the standard end-quench hardenability determination.

The bar generally reproduces cooling

Continued on page 86

SAE Committee S-1, Aeronautical

Drafting Manual, invited and received the participation of drafting heads of leading West Coast airframe plants at its recent meeting in Hollywood, Calif.

Among the guests who attended Committee S-1's meeting are those at right with Chairman P. G. Belitsos (center). They are, left to right: J. H. Holter, Boeing; C. L. Cutshaw, Lockheed, California Division; Belitsos; R. H. Stearns, Douglas, Santa Monica; and J. C. Crawford, Douglas, Long Beach.

Chairman Belitsos said that his Committee is eager to learn of the problems facing draftsmen in the various phases of the aeronautic industry . . . engines, airframes, accessories, propellers, and airline operations. He feels that such knowledge will help keep the SAE Aeronautical Drafting Manual a living, useful tool that reflects current drafting practices, satisfies present needs.

He expressed his appreciation to the above guests from the airframe plants for their active participation in the Committee meeting and their report on drafting problems peculiar to their type of production.

1955 SAE Technical Board

C. A. Chayne, Chairman

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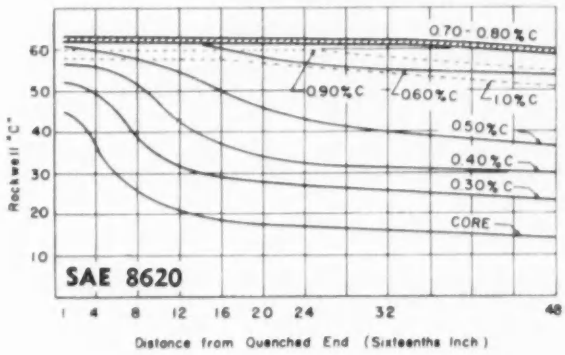
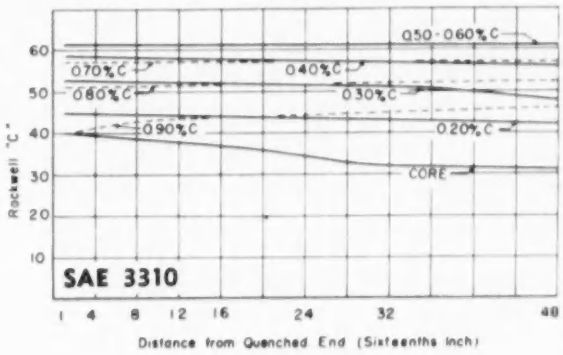
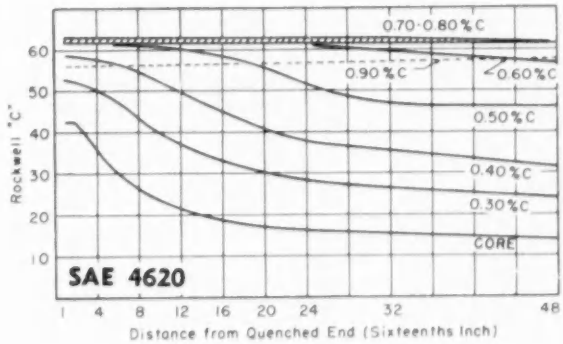
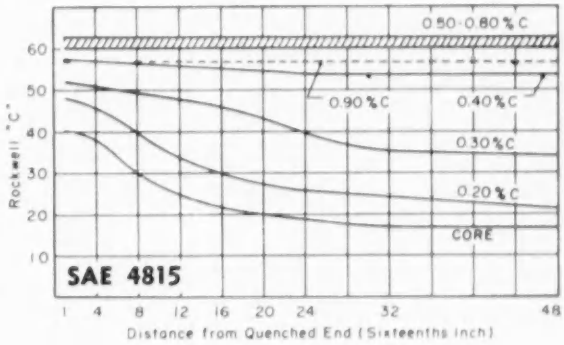
E. F. Norelius
Harold Nutt
A. E. Smith
B. G. Van Zee

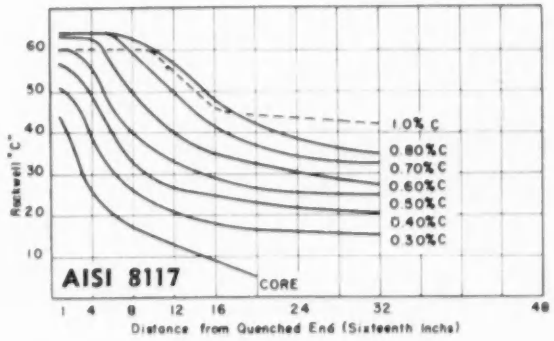
Summaries of Hardenability Data on Carburizing Steels

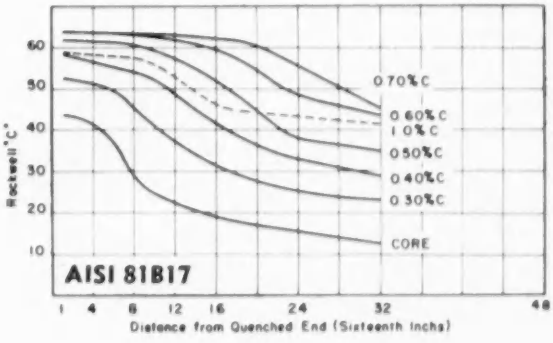


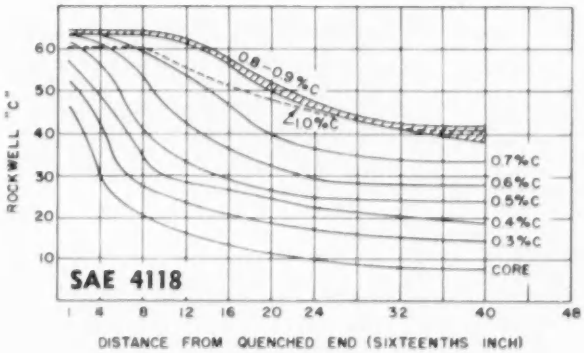


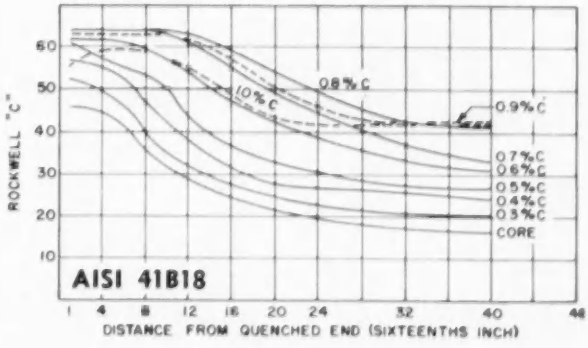




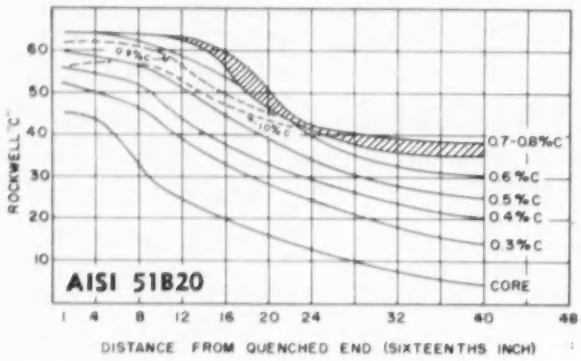


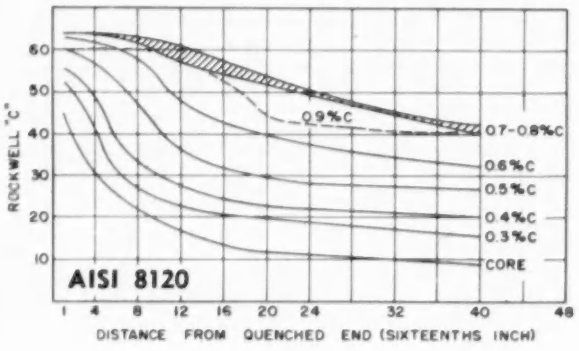


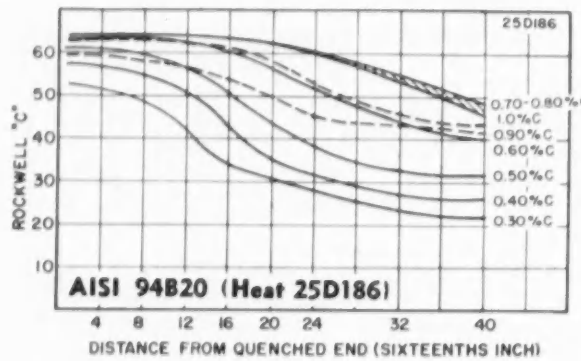


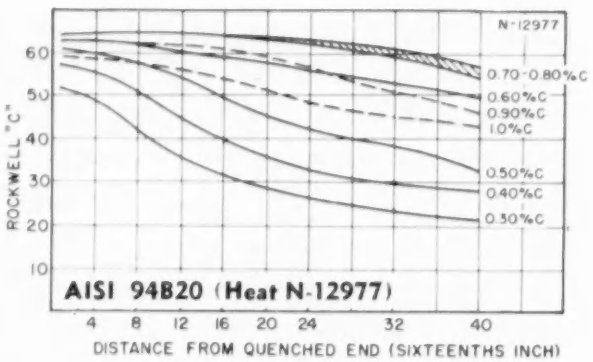


Summaries of Hardenability Data on Carburizing Steels





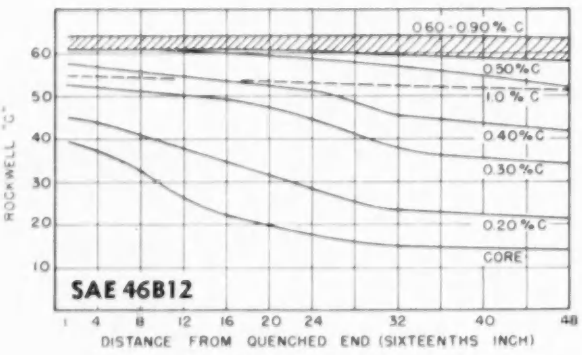




Continued from page 84

conditions found in the standard end quench bar although it has been pointed out in discussion by C. F. Jatczak and A. L. Christenson in the Transactions of American Society for Metals, Vol. 45, 1953, pp. 1076–1078 that cooling rates near the corners of the bar do not exactly coincide with the standard test bar cooling rates. This does not, however, affect the comparison of hardenabilities of the various steels at various carbon levels.

In conclusion, Thomson observed that one cannot predict case hardenability solely from a knowledge of core hardenability.



Aero Materials Specs Reviewed by Industry

DRAFTS of eight SAE Aeronautical Materials Specifications are currently being circulated to industry for comment and criticism by the SAE Aeronautical Materials Specifications Division.

Copies of all these specifications are available for review from the SAE Aeronautical Department, 29 West 39 Street, New York 18, N. Y.

The specifications under review are:

- AMS 3356—Silicone Rubber, Lubricating Oil and Compression Set Resistant (55–65);
- AMS 7452E—Bolts and Screws, Steel, Alloy;
- AMS 7456C—Studs, Steel, Alloy;
- AMS 7470B—Bolts and Screws, Steel, Corrosion Resistant;
- AMS ——, Gaskets, Type XX Engine Accessory Drive, Corrosion Resistant Steel Screen Reinforced;
- AMS ——, Synthetic Rubber, Fire Resistant (50–60);
- AMS ——, Synthetic Rubber, Fire Resistant (70–80);
- AMS ——, Synthetic Rubber Sheet, Nylon Fabric Reinforced Weather Resistant-Chloroprene Type.

SECTIONS

NOVEMBER 1955

FE's Aiming at a Story-a-Month for Journal

MANY field editors are already in action on news and special stories for these revised Section pages of SAE Journal. Most are aiming for at least one "how-we-do-it" story a month, in addition to special news about Section activities. Field editors, in a number of instances, laid the groundwork for a year's program of Journal stories by getting their Governing Boards interested in this new opportunity to tell the whole SAE world about Section achievements.

Said Detroit Field Editor W. F. Sherman, for instance, to his Governing Board at its August 26 meeting:

"SAE Journal is revising its method of handling news of local Sections, beginning with the October issue. Primarily they are going to be interested in reports of how the Sections do things.

"So, I am going to be in touch with many individuals on the board asking them either to prepare material for publication or supply me with material that I can write up pertaining to their particular activities.

"We will want to do the Long-Range Planning Committee work, the Programs Committee activities, the Junior-Student program, and the activities of the Strategy Committee, the Reception Committee, Company Representatives, and Meetings Operations."

Similar planning and action is on its way by other field editors to tell about a part of their Section activities story *every* month. There is talk of presenting a gold-plated humming bird's tooth to the field editor whose Section heading appears the greatest number of times in the 1955–56 Section year.

COLORADO

G. A. Bigelow, Jr., Field Editor

RACKS will be available in 1955–56 to hold member identification badges. Placing a badge in the rack at the end of a meeting, the member will be able to find it more conveniently than in the past when he comes back to the next meeting.

CLEVELAND

W. B. Fiske, Field Editor

"Junior Journal" Speeds Placement Work

—Wilson B. Fiske

Up until the 1954–55 season, Cleveland like many other SAE Sections had a Placement Chairman appointed as a member of the Governing Board, and he was available to members who wished information regarding positions open to SAE members. However, the service was not publicized to any extent and very little advantage was taken of it.

But **D. R. McRitchie** of GMC's Chevrolet-Cleveland Division, when appointed Placement chairman by Section Chairman Carl A. Bierlein in August, 1954, made a special study aimed at improving the service. First, he contacted his predecessors, and then he wrote to Elizabeth V. Reidy of the SAE Placement Service in New York asking for all pertinent forms that a Placement Contact should have. By return mail he received the literature, forms, and information that were available.

To adapt the headquarters system to local needs McRitchie hit upon the idea of using a page each month in Cleveland Sections' "Junior Journal" listing four of the most likely positions that would appeal to local area members. His name and business phone were given for further contact on jobs listed and the New York office for placement service was also listed. The rest was up to the individual who might be interested.

When a phone call is received as a result of the publicity given placement service in the Cleveland Section publication, the caller's eligibility and date of membership is first established. Then, address and phone number are obtained and, after verification of his membership, the most recent placement list is sent to him by mail in a large manila envelope along with a return stamped and addressed envelope with instructions to return within five days. The mechanics of this procedure are handled by McRitchie's secretary, and as the phone calls come in they are turned over to her for handling.

McRitchie

As a result of the effort to provide better placement service, there is a steady flow of telephone calls and approximately three to four men are furnished the information and listings each month. It is recognized that times were generally prosperous during the

Dr. Rosen Tours Hawaii

Dr. Rosen's very enjoyable visit to Hawaii, August 17–September 4, included the memorable occasions pictured at the left.

Above: Dr. Rosen tours a sugar mill with **A. F. Wallace**, factory superintendent, Waialua Agricultural Co.

Below: Dr. Rosen sits in on Hawaii Section meeting with (left to right) **K. M. Watson**, Section chairman; **G. W. Etheridge**; and **I. B. Palmer**, Section vice-chairman.

1954–55 season and even more contacts would have been made if there were a period of recession.

To give fast service and to have information on hand at all times, McRitchie recommends that a copy of the positions available be retained in the Placement chairman's office at all times for reference. Thus it is necessary to have two copies or more, one or more for circulation as called for and one to be retained. No detailed records have been kept as to the number of placements resulting from this service, but the appreciation of members has been voiced, and many have obtained new positions.

Contacts with the members indicate that what they want is quick service, and the Cleveland Section has endeavored to give it to them.

With the beginning of the 1955–56 season and new appointments, H. C. Simons, Heater Division, Eaton Manufacturing Co., has been named Placement chairman, and McRitchie is filling another position on the Governing Board. Simons is continuing the system which proved so successful last season—the system of listing typical positions open in the area in the "Junior Journal." In addition, he has listed men available. As an example, the October issue of the Cleveland Section paper carried four typical positions open and two men available for positions. Always there is reference to the SAE National Placement Service.

"Package Deal" Meetings Successful

The Cleveland Section has stimulated great interest among its members by frequently offering a "package deal" in which an event is tied up closely with a meeting and meeting subject. Among the many examples for instance were meetings and discussions on the automatic transmissions, preceded by test runs with various cars; a meeting on power steering preceded by test driving of cars with power steering.

The October 10 meeting featured a

talk on the St. Lawrence Seaway Project; and as a forerunner to that, the members took a boat trip up the Cuyahoga River—an important Cleveland port facility—to see what had already been started in the way of engineering projects on bridges, docks, etc., which are a part of Seaway Project preparation. These meetings which combine a special event on the same general subject are highly popular.

FENN COLLEGE Student Branch took a boat excursion up the industrial valley of the Cuyahoga River, July 6. The boat traveled across one mile of the Cleveland lakefront into the mouth of the river, and then sailed five miles along the river. Members enjoyed watching industry at work along the riverfront; ore being unloaded from the hold of a freighter, grain elevators in action, and lines of freight cars being hauled across the river.

1. During introductions at the Sept. 26 meeting of Central Illinois are shown (left to right) Speaker **Forest R. McFarland,** Studebaker-Packard Corp.; **John I. Bucher,** Peoria Packard dealer; **C. H. Callahan,** Peoria area service representative; **Paul Saurs,** Peoria Packard dealer; **Harry Miller,** Bucher-Saurs service manager; **Bob Aller,** St. Louis district service manager for Packard; and **George Beres,** Pekin Packard dealer.

2. Meeting at the rostrum at the San Diego September Section meeting are (left to right) **P. M. Klauber,** San Diego Section meetings chairman; **Maynard L. Pennell,** speaker; and **R. G. Sharp,** San Diego Section chairman.

3. **W. K. Mathias,** manager of Grinding Machine sales, Cincinnati Milling Machine Co., demonstrates with a model at the Indiana Section Sept. 22 meeting.

4. "Satellite missiles could travel at 18,000 mph by use of rocket power in the next two years," said Speaker **R. L. Hirsch** (center left) of Aerojet General Co. With him are (left to right) Northern California South Bay Division Chairman **R. A. Hundley;** North Bay Division Chairman **W. G. Brown;** and Co-Program Chairman **W. A. Casler.**

5. Milwaukee Section officers gather for a Journal photograph. They are (left to right) **Dean G. Thomas,** treasurer; **Igor Kamlukin,** chairman; **E. H. Panthofer,** secretary; and **Phil S. Myers,** vice-chairman.

DETROIT

W. F. Sherman, Field Editor

Careful Briefing Is Potent Help to New GBs

—W. F. Sherman

Managerial forethought is applied to activities of the Detroit Section to keep the policies and programs modern and active.

A pointed example of the technique used by the 1955–1956 chairman of the Section, K. R. Herman, was the briefing which he gave to all members of the incoming Governing Board of the Section at a meeting on June 30. This briefing followed a pattern used in recent years and initiated by Harry E. Chesebrough, a former chairman of the Section.

Fourteen pertinent items were reviewed for the Board members starting with the fact that the SAE is an international organization in its scope and then dealing in detail with aspects of the Detroit Section organization and its relationship with the national Society.

Members were advised that the parent governing body of SAE is the Council which meets four times a year and that the governing body of the Detroit Section is the Board which meets generally every two months. This Board is composed chiefly of representatives of Professional Activities that are active in Detroit, of which there are nine.

The chairman outlined the Detroit Board as consisting of the chairman, vice chairman, secretary, treasurer, and vice-chairmen, with assistant vice-chairmen, representing the aeronautic, body, engineering materials, junior, passenger car, production, regional, student, and the truck and bus Activities. Of these, the junior, regional, and student are not national Activities but are peculiar to the Detroit Section and operate by special authority granted by the Council.

The chairman advised that experience in past years had established a need for a number of standing committees and each of these is represented on the Board by its chairman. These include the company representatives, editor of the "Supercharger," chairman of the Entertainment Committee, the field editor for the "SAE Journal," and chairmen of the Meetings, Operations, Membership, Placement, and Reception Committees.

Chairman Herman also introduced the two liaison representatives between the Detroit Section and the National Sections Committee and the National Nominating Committee. He also described the operations of the Nominating Committee and of the elections for national and local offices.

Detroit Summer Meeting

OVER 400 attended Detroit Section's Summer Meeting at White Sulphur Springs Sept. 9–11. Featured were technical sessions on fuel injection and body upholstery fabrics.

1. Leaders of the meeting were Section Chairman K. R. Herman (right) and Chairman of the Summer Meeting D. D. Robertson (left).

2. The fuel injection session brought sharp and informative discussion.

3. Responsible for the technical sessions were: Von D. Polhemus (center left), technical chairman of the meeting; C. W. Ohly, technical vice-chairman (center right); Errol J. Gay (left) chairman of fuel injection session; M. A. Thorne (right) chairman of textiles and fabrics session.

Detroit Section's Executive Committee, composed of the chairman, vice-chairman, secretary, treasurer, and the immediate past chairman of the Section, has been given authority, Herman said, to handle emergency items between Board meetings.

Herman also described the operation of the Meetings Strategy Committee, a specially planned group that meets before each Section meeting to arrange for the careful execution of all the details associated with staging the meeting in a smooth manner.

People familiar with the operation of the Detroit Section have given much credit to this annual briefing of new Board members for the steady growth and succesful operation of the Section.

The briefing discussed in this article usually occurs at the first meeting of the complete Board and, as in this instance, it generally occurs about the end of June or early July.

However, this is not actually the beginning of Detroit Section activities for any particular year. In this instance the last meeting of the previous Governing Board, which took place on April 28, included the reports, most of them in writing, of each of the Activity vice-chairmen and the chairmen of the standing committees. These reports and the recommendations they made

for conduct of future business in the Section were transmitted by the expiring Governing Board to the members of the incoming Governing Board for their guidance.

The new Board was organized immediately after this session and followed the regular Detroit Section practice of immediately creating a Meetings Committee with the responsibility assigned to that committee to prepare a complete schedule of meetings for the 1955–1956 session. This group met on June 23 so it was able to submit at the June 30 meeting a proposed program for the entire session. Action on this proposed program was the first important order of business of the new Governing Board after it had been briefed by the chairman.

Philadelphia

M. K. Simkins, Field Editor

Student Impetus Grows from '52 Start

—Murray Simpkins

The Philadelphia Section has a hearty appreciation for the part students will play in tomorrow's engineering. The Student Activity Program attests to that faith. The results of a stepped up activity for the past two-year period proves that college students need and desire the assistance that only an organization like the SAE can provide.

When the Section decided back in 1953 that it needed more student representation, Lee DuMont of DuPont as committee chairman set about to spark the program with innovations that may interest other Sections.

He sent special invitations to the Section's Student Night to **all students** registered in engineering **in all of local colleges and universities.** He invited all engineering faculty members to be guests of the Philadelphia Section for that evening. Then, group photographs were taken at the meeting and copies were sent to each of the students and to the schools for posting on their respective bulletin boards. Tear sheets containing the write up of the meeting from the SAE Journal were similarly distributed. And all students attending the meeting were placed on the mailing list to receive Section meeting announcements.

In addition notices and programs of National meetings were obtained regularly and were sent to the schools for their bulletin boards. The aim: to impress the body with the scope of the SAE sponsored activities. During the year some SAE Handbooks were sent to both students and faculty.

Results of this stepped up program brought 89 students and 6 faculty members to the Student Night of 1954. This represented more than the total student membership in the 10 schools with SAE representation.

A. T. Cowell, Student Activity chairman for 1954–55 continued and accelerated the program laid down by the earlier Committee. As a result, he brought the Section's total of Enrolled Students from 56 in May, 1954 to more than 100 in May, 1955.

Special effort by the 1954–55 Committee made available to each college in the area a list of possible speakers, tours, and demonstrations. Each Committee member was assigned as contact-for-the-year to one or two schools. This Committee also gave assistance in getting speakers for SAE school-sponsored events. In addition, it worked overtime to create more student interest in SAE's national programs and activities.

Recently a new Student Branch was installed at Pennsylvania Military College—and an SAE Club is in process of formation at Drexel.

1955–56 Student Activity chairman Don Osterhout is emphasizing continued cooperation with each of the colleges in the Section's area. This year's Student Night, held on October 12, was the same fine success as its predecessors.

ATLANTA

G. F. Jackson, Field Editor

2-Pronged Action Doubles Membership

—Grant F. Jackson

Continued emphasis on a 2-pronged membership campaign brought a 52.9% membership increase—and achievement of full Section status—to Atlanta in its 1954–55 Section year.

The membership success results, Section officers believe, from:

1. Stimulating every Section member to try to bring in new members; and
2. Setting an unusually high average of interesting meetings and good speakers.

The Section Chairman and his Governing Board, as well as the Membership Committee itself, works constantly toward these two ends.

Specifically helpful actions taken during the last Section year include:

1. Increase from three to six of members of the Membership Committee itself.
2. A special table at each meeting bearing application forms and ever-changing slogans urging individual members to help get new members.
   (Recent slogans include: "Application Forms—Take one for that friend who should be a member"; and "Application Forms—Have you brought in a new member yet?" . . . Colors are changed on the signs each meeting, also, to keep the effort alive and fresh-looking.)
3. Student membership has been actively promoted. Section Student chairman William Law and Section Secretary Ernest Troutman helped get SAE activities started at the Georgia Tech Automotive Club. Most of this Club's students have since become SAE Enrolled Students. They have added both prestige and interest to regular Section meetings.

The extra effort toward high-quality meetings brought to Atlanta last year top engineers from various well diversified fields of industry . . . automotive, aircraft, petroleum, plastics, and others. The spontaneity and length of the question and discussion periods after every meeting attested the fact that the speakers interested their audiences.

The Section that intends to grow, Atlanta officers believe, cannot depend on its Membership Committee alone. Every member of the Section must be stirred to become a one-man membership drive.

LIST of guests carried regularly on the Section mailing list for meetings notices has just been rechecked to eliminate those who don't wish to receive notices.

SEPTEMBER meeting was held at the Briarcliff Hotel—a new meeting place. Decision will be made after that meeting about where later 1955–56 meetings are to be held.

GOVERNING Board will continue for 1955–56 the practice of buying an SAE lapel pin as a gift for each new member of the Section. (A modest supply of lapel pins will also be carried on consignment to supply others who may wish to buy.)

Mid-Michigan

G. W. Colby, Field Editor

Membership Lead Stems from Action

—Gerald W. Colby

Two seasons of undisputed leadership in membership growth for Sections

in its size category have not surprised veteran members of the Mid-Michigan Section. In addition to being located in a very fertile area of potential members, the Section has developed a simple but effective Membership Committee procedure.

The geographical boundaries of the Mid-Michigan Section contain the automotive manufacturing cities of Flint, Lansing, Saginaw, Owosso, and Midland. Located in these five cities are 14 firms that employ enough SAE members and potential members to warrant a plant representative. One duty of each plant representative is new membership promotion. This type of Membership Committee has functioned very satisfactorily in the Mid-Michigan Section for several reasons:

The Program Committees of the Section have attempted to **promote outstanding meeting programs.** These have aroused the interests of many engineers to the extent that they want to become a part of the Society.

A second reason for Membership Committee success is that **each plant representative is prepared** for the job of membership promotion. This is done at a Committee dinner meeting in the late summer. This summer meeting is usually the only one needed during a Section year. At this meeting, each plant representative is supplied with membership incentive literature and application forms. Advantages of Society membership are reviewed and the Committee members are instructed as to how they can help applicants when application forms are filled out. Emphasis is placed on the fact that membership grade is determined largely from the information contained in the application.

Another factor which has led to a high growth rate for the Mid-Michigan Section has been **the caliber of Membership Committee chairmen.** Since the outstanding performance of Carleton J. Lauer during the first two seasons of Section operation, the eight succeeding chairmen, including the present chairman, Morris R. Graham, have constantly strived to make the Section a leader in the introduction of new members.

The membership chairman takes pride in **introducing new members** to the Section at one of the year's regular dinner meetings. At this time, the new members are presented with SAE lapel pins.

The Membership chairman also prepares **a periodic news letter** to advise the plant representatives of overall Section progress.

Student membership activities are effectively handled by the student councilors of the two SAE Student Branches located in the Section territory. These men are members of the Membership Committee. They are aided in their student work by being able to offer students dinner tickets at reduced rates for regular Section meet-

Section

ALBERTA

November 18 . . . Harris Sky Room.

BRITISH COLUMBIA

November 14 . . . **V. A. Gates,** Production Application Department, Shell Oil Co., San Francisco, Calif.—"Interpretation and Application of 'On the Spot' Testing of Used Engine Oils." Hotel Georgia. Dinner 6:30 p.m. Meeting 8:00 p.m.

BUFFALO

November 15 . . . **W. H. Johnson,** chief engineer, Continental Division, Ford Motor Co., Detroit —"The New Lincoln Continental Mark II." Hotel Sheraton. Dinner 7:00 p.m. Meeting 8:00 p.m.

CENTRAL ILLINOIS

November 28 . . . **Col. Peterson,** Detroit Arsenal—"Ordnance and Industry." Pere Marquette Hotel. Dinner 6:30 p.m. Meeting 7:45 p.m.

CHICAGO—South Bend Division.

November 21 . . . LaSalle Hotel, South Bend, Ind. Dinner 6:45 p.m. Meeting 8:00 p.m.

CINCINNATI

November 21 . . . **John M. Reinhart,** chief stylist, Ford Motor Co.—"Continental's Mark II." Engineers Building. Dinner 6:30 p.m. Meeting 8:00 p.m.

CLEVELAND

November 14 . . . **Major General Hendricks,** Department of the Army—"Missiles." Manger Hotel. Dinner 6:30 p.m. Meeting 7:45 p.m.

DETROIT

December 12 . . . **Ross A. McFarland,** Harvard School of Public Health—"Human and Environmental Factors of Automobile Safety" and **A. L. Haynes,** Ford Motor Co.—"Design Factors in Automotive Safety." Body Activity Meeting. Rackham Educational Memorial.

INDIANA

November 17 . . . **Donald S. Hersey,** Pratt & Whitney Aircraft Division, East Hartford, Conn.—"Personal Economics for Engineers." Special Features: Social Half-Hour 6:30 p.m. Marott Hotel, Indianapolis. Dinner 7:00 p.m. Meeting 8:00 p.m.

KANSAS CITY

November 14 . . . **I. Irving Pinkel,** NACA—"Aviation Crash Fire Control." Public invited.

December 5 . . . Automotive Fuel. Speaker not announced.

METROPOLITAN

December 1 . . . **P. A. Colman,** Lockheed Aircraft Corp.—"Electra Airplane (Turbo Prop Transport)." The Brass Rail Restaurant, Fifth Ave. & 43rd St. Cocktail Hour 5:30 p.m. Dinner 6:30 p.m. Meeting 7:45 p.m.

Meetings

MID-MICHIGAN

November 14 . . . **James B. Franklin,** vice president in charge of operations and maintenance, Capital Airlines, Washington, D. C.—"Capital Airlines' New Viscount." Bishop Airport, Flint, Mich. Dinner 6:30 p.m.

MILWAUKEE

December 2 . . . **Russell Sanders,** chief passenger car chassis design engineer, General Motors, Detroit—"New Chevrolet V-8 Engine." Milwaukee Athletic Club.

MONTREAL

November 21 . . . **D. G. Richards,** chief of vibration & mechanical metallurgy, United Aircraft Corp., Hamilton Standard Division. — "Stress Concentrations." Mount Royal Hotel. Dinner 7:00 p.m. Meeting 7:45 p.m.

NORTHERN CALIFORNIA

November 16 . . . **H. M. Mulder,** assistant zone manager, Allison Division, General Motors Corp., Beverly Hills, Calif.—"The Allison T-56 Turbo Prop Aircraft Engine." Special Features: Field Trip through NACA Ames Aeronautical Laboratory, 2:00 p.m. same afternoon. Hotel Ben Franklin, San Mateo. Dinner 6:30 p.m. Meeting 8:00 p.m.

NORTHERN CALIFORNIA—South Bay Division

November 1 . . . "Euclid TC-12, Twin Diesel Tractor." Old Plantation Restaurant, Los Altos, Calif. Dinner 7:00 p.m. Meeting 8:00 p.m.

ST. LOUIS

November 21 . . . **Carl H. Mueller,** director of engineering, Lincoln Engineering, St. Louis—"Centralized Chassis Lubrication." Parts & Accessories Activity Meeting. Gatesworth Hotel. Dinner 7:00 p.m. Meeting 7:45 p.m.

SOUTHERN CALIFORNIA

November 21 . . . **W. E. Achor,** chief engineer, Thompson Products, Inc.; **S. E. Elerbe,** fleet engineer, Ethyl Corp., West Coast Region; **L. J. Grunder,** manager of Fuels & Lubes, Development Department, Richfield Oil Corp.; and **Cliff Collins,** president, Harman & Collins, Inc.—panel on "Valve Problems." Ethyl Corp Auditorium. Meeting 8:00 p.m.

December 5, 6, and 7 . . . AIRCRAFT RESEARCH SEMINAR
Subject: Environmental Testing —Aircraft & Missiles
Dec. 5 . . . "A look into the future and a comparison to the Present Environmental Requirements."
Dec. 6 . . . "Complete Systems and Flight Tests From the Standpoint of the Prime Contractor."
Dec. 7 . . . "Environmental Testing of Detail Parts and Sub-assemblies." The University of California at Los Angeles. Sessions begin 7:00 p.m.

TEXAS

December 9 . . . Aircraft.

TWIN CITY

December 7

WILLIAMSPORT

December 5 . . . **J. D. Pisula,** engineer, Corning Glass Works. —"Glass and Precision Metal Castings." Moose Home. Dinner 6:45 p.m. Meeting 8:00 p.m.

Metropolitan

Leslie Peat, Field Editor

Changed Program Ups Student Results

—Randolph P. Dominic

From all indications, the Metropolitan Section has found the key to improving Student Branch activities.

The importance of Section student meetings has long been recognized both as an adjunct to an engineering curriculum and a training ground for future SAE activities. However, the problem has been to find what the senior members can do to stimulate student interest and help them present better programs. Last year when Andy Ashburn took over as Met's Vice-Chairman for Student Activity he decided to take several specific steps.

His first move was to sponsor a dinner for Student Branch officers and faculty advisors. Each of the four Student Branches in the Met Section area were represented at the dinner. These guests were invited to ask questions, present their problems, and make suggestions as to how the Met Section could help them improve their own operation.

One outcome of this November, 1954 dinner was abandonment of the previous custom of holding one Met Section meeting primarily for students each year.

Instead, the four colleges decided to sponsor, with the Met Section, a joint program of their own at New York University in March.

The students selected the time, place, and topic for the meeting with the Section's Student Vice-Chairman giving assistance in publicity and in contacting prospective speakers. Through

ings. Student members are encouraged to continue their association with the Society after graduation. Those who remain within the Section territory are approached by the plant representatives where they become employed.

Despite the work with young engineers, the largest percentage of new members is composed of established engineers who have been approached by the plant representatives and, as a result, have become aware of the advantages of SAE membership.

Membership chairman Graham feels the most important result of his committee's work has been that more engineers, through SAE membership, are able to advance both individually and collectively because of the Society's most basic aim, the interchange of knowledge.

this work Ashburn discovered what may be a problem common to all Sections. Apparently, the students are not aware of who the prominent men in various fields are. And even when they do know, they are somewhat reluctant to approach these men to speak before their group.

The program for the NYU meeting consisted of a tour of the University laboratories, an informal dinner in the cafeteria, and a technical session on gas turbines. Guest speakers were Charles Hill, of Ford Motor Co., and Robert Marwood, of Solar Aircraft. The program's success was attested by the attendance of about 200 students and members. Only one-fourth that number had turned out for former Met Section student meetings.

Student members are regularly invited to all Met Section meetings. Although most programs attract only a handful, those who do attend get ideas for their own organizations.

This year an Assistant Vice-Chairman has been added to the Governing Board so that more attention can be devoted to student affairs. The joint meeting will be held this fall instead of waiting until spring. Thus, the students will have almost a full school year to capitalize on whatever inspiration and assistance they receive.

Met GB Approves 9 Aims for Section Year

MET Section Chairman R. M. Cherryholm started his August Governing Board meeting by getting approval of nine specific goals for the Section's activity in 1955–56. "Our policy," he said, "is to look forward." Met's current and specific aims are to:

1. Select best possible topics and speakers for meetings;
2. Foster an atmosphere of friendliness in which members and guests feel at ease;
3. Appoint plant and office representatives to keep in better touch with present and prospective members;
4. Increase attendance at dinner, activity, and luncheon meetings;
5. Investigate need for a "Division" of Met Section in Long Island;
6. Collaborate with other local engineering groups for mutual benefit;
7. Make executives more conscious of what SAE can mean to their employees;
8. Work closely with faculty adviser and chairman of each Student Branch to help get good speakers and meeting topics; to inspire students and point up advantages of a career in engineering;
9. Increase membership.

MET has accepted an invitation to have SAE's 1956 L. Ray Buckendale Lecture presented at a Met Section meeting . . . probably in the Fall of 1956.

SPECIFIC responsibilities assigned to plant representatives by Met Section Membership Chairman Frank Lary are:

1. To stimulate attendance at Section meetings:
   a. Post notices in plant or office
   b. "Talk the meeting up"
   c. Take reservations for meetings, checking with individual members and guests he thinks interested
   d. Possibly arrange car pools for attendance at meetings
2. To stimulate SAE membership:
   a. Have application blanks at hand
   b. Talk membership to *qualified* prospects
   c. Advise membership chairman of prospects plant representative thinks could best be contacted by someone other than himself
   d. Follow-up prospects referred to him by membership chairman
3. Keep ears open for suggestions and complaints about Section activities. Pass these on to membership chairman, who will report to Governing Board.

CHICAGO

P. P. Polko, Field Editor

Chicago Play-Day— A Hit For Twelve Years

—I. R. Dawson

A now traditional Play-Day and Golf Party has paced the entertainment activities of the Chicago Section for twelve years.

Early in September each year, the Section members and their guests enjoy a full day of social activity in one of the larger country clubs in the Chicago area. Tickets sold to the members cover dinner and golf, or just the dinner for those who cannot get away all day. They also entitle him to the facilities of the club house and participation in the prize drawing, which has become a regular feature of the event. Prizes are donated by the Entertainment Committee and a long list of selected donors.

The day invariably includes "special event" holes on the golf course, 19th hole refreshments, good entertainment, good dinners. A convenient buffet lunch is arranged to minimize the time lost to the other activities.

This year the Chicago Section's Twelfth Annual Play-Day was held Friday, September 9th, and as usual was attended by some 500 golfers (good, mediocre, very mediocre), all out for fun. The details are published each year in the "S.A.E. Chicago Section News."

The event is handled by the Entertainment Committee, which names a special Play-Day and Outing chairman. This year Ed Hendrickson, Hendrickson Manufacturing Co., heads the Entertainment Committee, and E. F. Donham, Illinois Bell Telephone Co., directed the Play-Day activities.

MONTREAL

A. A. Larkin, Field Editor

4th-Year Placement Plans Set New Goals

—A. A. Larkin

Montreal Section's placement program is now going into its fourth year of activity under the direction of chairman Fred H. Moody. Moody organized Montreal's first placement program and has headed up this work ever since.

"Our first chore," says Fred, "was to develop a placement service that was purely Canadian. We had no basic objections toward using the most excellent service provided at SAE Headquarters in New York. But our main concern was to keep our trained young men in Canada, and to fill jobs that opened up here with Canadians. Appreciating these objectives, SAE Headquarters has entered whole-heartedly into our ideas."

"Next step was to arrange for notices to be placed in our monthly Section bulletin. This has been done regularly ever since. Now we are trying to expand this service through a reciprocal arrangement with other Canadian sections."

"I would say that we made about 15 company contacts during the past year. This has been supplemented by brief talks which the Section Chairman has invited me as Placement Committee Chairman to make at Section meetings. And, of course, we talk about our service anytime we can get enough people together to listen to what we have to say.

"We have found the Placement Service at SAE Headquarters in New York very co-operative whenever we have needed their help. From time to time

Sections

they have sent us requests for services from Canadians and these have been published in our Section bulletin in the usual way."

Up to now Montreal Section placement work here has been pretty well confined to job procurement with recent college graduates, SAE Junior members, and older members benefiting about equally from help given to date. A big job remains to be done in:

(a) guidance toward getting a job, and

(b) vocational guidance.

Need for work in both of these fields is growing as Canada's booming economy brings continuing expansion in both numbers and kinds of jobs opening up for engineers.

Montreal's placement committee will be expanded to meet the growing needs for its services. Up to now Chairman Moody has carried the ball almost single-handed. But he is looking forward to having much more help this year in his work to make his placement services more widely known and used.

MONTREAL Section has a TELEPHONE COMMITTEE. Its members will each telephone a list of prospective attenders before each regular meeting of the Section.

Membership Chairman W. G. Dewar supplies Telephone Committeemen with lists by letter. After calling the names of their list, members of the newly-formed TC will advise Arrangements Committee Chairman M. J. Bourgault (by telephone, of course) how many to expect.

MONTREAL presents membership pins to new members on occasion of their joining the Society. This year a "New Members" table will be set up at each meeting.

Williamsport

C. F. Pannebaker, Field Editor

The Year's Program Is Everybody's Business

—H. J. Lavo

Williamsport Group has successfully demonstrated seven of the principal essentials for good program planning. They are:

1. Utilize your governing board's collective imagination to the utmost,
2. Aim high enough,
3. Take a positive initial approach to prospective speakers,
4. Make arrangements to meet speakers on their arrival,
5. Be certain that speakers are properly housed and fed,
6. Turn out large and appreciative audiences, and
7. Keep doing these things everlastingly through the years.

All this presupposes that your Section or group wisely chooses its Meetings chairman, delegates the necessary authority to him, and follows thru to see that he becomes a real work horse (i.e., utility vehicle). In the Williamsport operation, the Meetings chairman is directly responsible for most of the effort.

This year's governing board met early in June with John Hospers, 1955–56 Program chairman. Every member threw out suggestions for topics or speakers. These ideas were evaluated in a round table discussion. Those worthy were added to a prospective list presented by Hospers. The topics listed represented perhaps twice the number of meetings planned for the coming year, insuring suitable leeway for attrition due to time and distance factors.

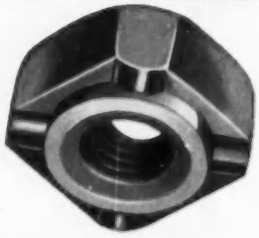
Past experience dictates use of topics

Here's the integral drive square...
...introduced by S.S.White 28 years ago and still the standard for speedometer cable!
S. S. WHITE "FIRSTS" have meant better, more economical speedometer cable
FIRST to pioneer the use of flexible wire wound cable.
FIRST to introduce automation in speedometer cable manufacturing.
FIRST to develop machines for arc-cutting speedometer cable.
FIRST to introduce integral drive squares.
FIRST to develop satisfactory swaging equipment for speedometer cable.
FIRST to develop small diameter, thin wall speedometer casing.
FIRST to introduce galvanized casings for speedometer service.
S-5
The integral drive square is formed by swaging the end of a flexible shaft speedometer cable into an accurate square. It provides a driving end which needs no machined end fittings. It makes the use of a small diameter casing practical, thus reducing the cost of the entire speedometer drive combination. It also eliminates 90% of the cost of machined end fittings as well as the uncertainty of whether the end fitting is properly attached.
Introduced by S.S.WHITE in 1927, the integral drive square is now standard for all speedometer cables. Over the years, the savings that have accrued from this development have been tremendous.
During the last 50 years the many developments in speedometer cable design and manufacturing originated by S.S.WHITE have brought about outstanding improvements in speedometer cable economy, performance and dependability. That's why it will pay you as an automotive engineer to specify S.S.WHITE CABLE from your speedometer supplier.
S.S.WHITE INDUSTRIAL DIVISION 10 East 40th Street, New York 16, N. Y.
S.S.White
FIRST NAME IN FLEXIBLE SHAFTS

MIDLAND WELDING NUTS

...Make Tough Jobs Easy!

SAVE TIME!
SAVE TROUBLE!
SAVE MONEY!



If you've got a product involving metal fabricating, fastening or assembling, chances are you can use Midland Welding Nuts to big advantage.

They come in all sizes for every-sized job. Welded to the part or parts concerned, they don't have to be held while bolts are turned into them. Thus one man can often do the work of two.

And they're indispensable when it comes to those tucked away, hard-to-get-at places. Welded in advance to those inside spots where it is difficult—or *impossible*—for hands or tools to reach, Midland Welding Nuts hold fast while bolts are turned into them.

If you're a designer, you'll want to know about these time and labor-savers, too. Midland Welding Nuts will solve and simplify many of *your* problems, too.

Write or phone for complete information!

The MIDLAND STEEL PRODUCTS COMPANY

6660 Mt. Elliott Avenue • Detroit 11, Michigan

Export Department: 38 Pearl St., New York, N. Y.

Manufacturers of

Automobile and Truck Frames • Air and Vacuum Power Brakes
Air and Electro-Pneumatic Door Controls

Sections

Continued from page 95

which guarantee member interest, hence good attendance, such as:

1. New designs in aircraft propulsion (i.e., ramjets, atomic engines, etc.)
2. Automotive topics covering new designs (i.e., turbo-powered vehicles, etc.)
3. Advanced aircraft designs (i.e., vertical take-off categories, etc.)

The Williamsport Group tries to make each meeting equal in interest to meetings of the largest Sections. To that end the Section attempts to obtain speakers who have previously addressed national meetings. This can be accomplished 4 times out of 5, but sometimes the accomplishment may involve several years of continued effort. "If at first you don't succeed, —" we live by that old saw. 'Boss' Kettering is a marked man—he's on our list! Engineers are nothing if not persistent.

The Williamsport Group does not announce its year's program as such. Each meeting notice carries an announcement of the following month's speaker and topic. Usually final arrangements for speakers are concluded about 4 months in advance. In this respect the Williamsport Meetings chairmen have found the advice of the SAE headquarters to be very good and every effort is made in initial letters to prospective speakers to follow the positive suggestions of the National Office.

On fundamentals, our Meetings chairman never forgets to write to departed guests, expressing sincerely the Group's thanks for job well done. He does not overlook sending newspaper clippings reporting the Meeting. These things may or may not be important to the speaker, but they will be important to his sponsoring company.

One further note referring to the "large appreciative audiences." Hard work does this job. Members of the Governing Board make many phone calls to SAE members and interested persons reminding them of the occasion. Some prospects make reservations only when reminded how good the last steak tasted. Others need personal prodding to decide in favor of SAE when two other meetings demand their attendance. Engineers are people.

CINCINNATI

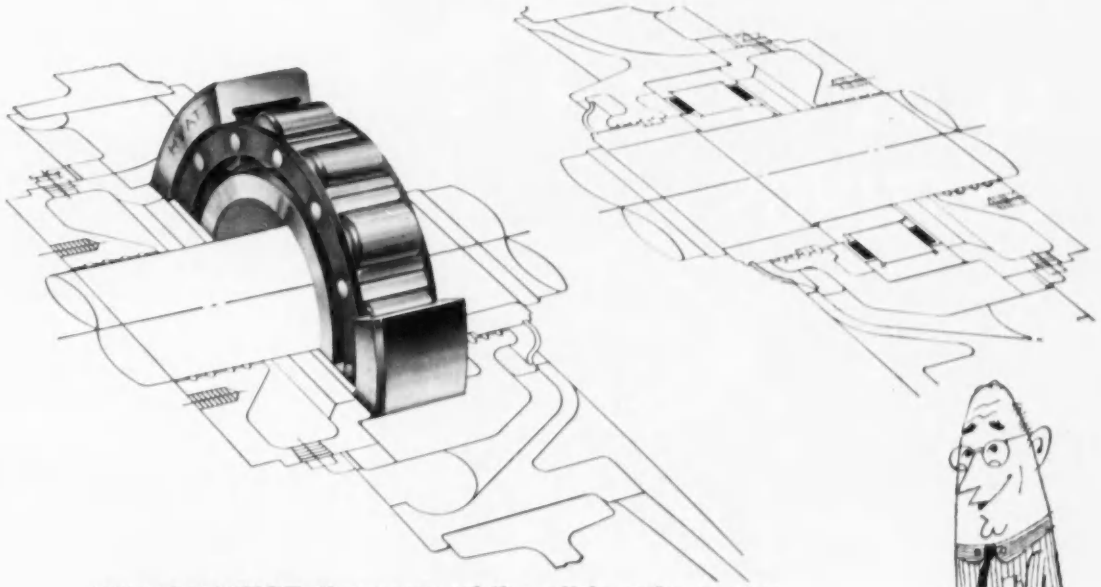
H. E. Pitzer, Field Editor

GOVERNING Board last summer questionnaired all Section members about subjects and topics of interest for 1955–56 meetings.

Following analysis of the poll, Sec-

How Hy-Loads can help you . . .

OVERCOME OVERLOADING



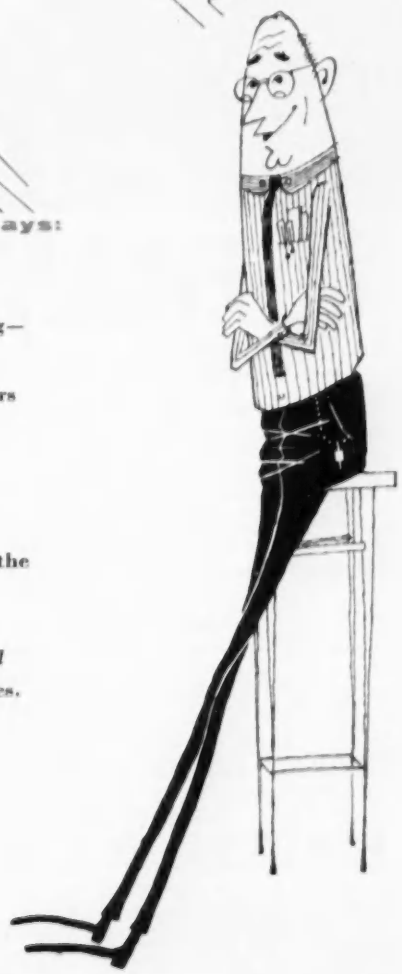
HY POTENUSE, the sage of the slide rule, says:

This HYATT Hy-Load is heading for a long hard life. It's been designed into as tough a job as you can hand any bearing—the armature shaft of a steel mill motor.

These HYATT Bearings must maintain the armature on centers with very close running clearance despite the fact that *steel mill motors are frequently overloaded and are regularly reversed under full load!*

But ability to "take it" isn't the only reason leading motor builders mount HYATTS on both ends of armature shafts: the offset of the flanged inner race provides vital *inbuilt, non-adjustable free end float*, permitting the armature to center itself electrically. What's more, HYATT'S *separable and interchangeable* races facilitate quick replacement of armatures.

See why so many smart designers agree? *You can't go awry when you specify—*



YOUR COMPLETE LINE
OF CYLINDRICAL ROLLER BEARINGS

HYATT

ROLLER BEARINGS

STRAIGHT ○ BARREL ○ TAPER ○

HYATT BEARINGS DIVISION • GENERAL MOTORS CORPORATION • HARRISON, NEW JERSEY

NOW! LOW COST CLOSE TOLERANCE CASTINGS

CERAMICAST*

...Lebanon's new steel casting process offers purchasing agents and design engineers these quality and price advantages:

FOR QUALITY

- **CLOSE TOLERANCES.** As close as + or — .003" to .005" per inch.
- **INTRICATE SHAPES.** Ideally suited for producing castings of complex design and detail.
- **THIN SECTIONS.** Metal sections as thin as 1/32 of an inch. Knife-like edges down to .030" or less.
- **SMOOTH SURFACES.** Surface variations held to 125 micro-inches or better.

FOR PRICE

- **LOWER PRODUCTION COSTS.** Jobbing wood or metal patterns can be used. Design changes are quick and inexpensive.
- **REDUCED MACHINING COSTS.** Smooth, accurate castings greatly reduce or eliminate machining costs.
- **SHORT LEAD TIME.**

ADAPTABLE TO MANY CASTING SIZES AND ALLOYS — casting weights up to one hundred pounds or more. Carbon steel, conventional low alloys, stainless steels and the superalloys.

SEND US YOUR BLUEPRINTS. Our sales engineering department will show you how the revolutionary Lebanon CERAMICAST Process can be adapted to your project design.

*produced under licensing agreement with Shaw Processes, Ltd., London, England.

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LEBANON STEEL FOUNDRY

169 LEHMAN STREET LEBANON, PENNSYLVANIA

CARBON, LOW ALLOY AND STAINLESS STEEL CASTINGS

Sections

Continued from page 96

tion Meetings Chairman J. G. McKinney bulletined members: "An all-out effort will be made to fulfill the requests for meetings subjects you have indicated in your answers to the poll."

Mohawk-Hudson

L. L. Barger, Field Editor

ALL Section meetings in 1955–56 will be held at "The Crossroads" in Latham, N. Y. Decision was reached at the Governing Board's meeting last August.

INDIANA

V. L. Alexander, Field Editor

The Sept. 22 meeting of Indiana Section brought a special guest. A. C. Ereaut (right), technical director of Polson Motor Parts Co., Pty. Std., Melbourne, Australia, attended the meeting. He was a guest of Arthur M. Brenneke, Indiana Section representative on the 1956 national Annual Nominating Committee.

HAWAII

John F. Mellen, Field Editor

Initiative Spurs Good Program Planning

—K. M. Watson

Initiative on the part of every member has been the answer to Hawaii Section's special program planning problems. Cooperation of every mem-

Improved Dual Sealing... with Single Seal Economy

New 2-lip design with more effective sealing surfaces makes this the modern replacement specification for compound element seals . . . giving increased sealing efficiency at minimum cost . . . and more compact seal housing.

Made in two types, both with oil-, age-, and heat-resisting Victoprene synthetic rubber elements. Exclusive Victor mechanical and chemical bonding of element and metal case assures permanent single-unit structure.

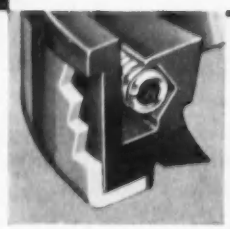
One-piece Victoprene Type K4 and K6 Oil Seals

TYPE K4 FEATURES

1. Dual sealing members for maximum retention of lubricant and exclusion of extraneous matter.
2. Valley between sealing lips retains initial lubricant for minimum friction and longer sealing life.
3. Unitary construction for minimum width requirements. Available in minimum width of 1/4-inch.
4. Available with or without Victoprene rubber on O.D.
5. Available with or without garter spring on primary sealing element.
6. External or secondary sealing lip molded with initial light interference permits satisfactory installation. Upon installation, the primary sealing lip displaces to increase sealing efficiency of secondary member through flex action.

Type K6 . . . without Victoprene on O.D.

For installations not requiring Victoprene on outer periphery and outside face of seal. Otherwise, design of 2-lip sealing element and unitary molded construction are identical with that of Type K4.



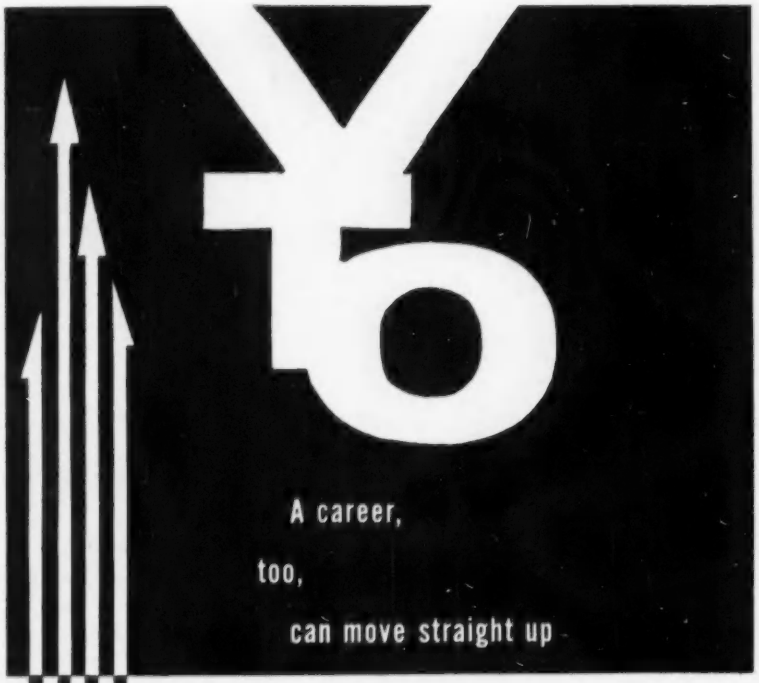
Complete information on K4 and K6 seals supplied through your Victor Field Engineer, or on request to the factory. Victor Mfg. & Gasket Co., P.O. Box 1333, Chicago 90, Ill.

THE MARK OF QUALITY
VICTOR
LEADERSHIP THRU PIONEERING

VICTOR

Victoprene Oil Seals

SEALING PRODUCTS EXCLUSIVELY



Specialists in VTO: Take a look at Fairchild's progress in this exciting field of modern aviation!

Here is real opportunity to make your mark in this important work, offered by the fast-growing, progressive organization that gave the world the famous C-119 *Flying Boxcar* and C-123 *Provider*. For now at Fairchild extensive research and development programs are in progress to create new VTO craft, as well as transports, fighters and missiles.

If you have experience in this field, and can make genuine contributions to its advancement, then you have an important place at Fairchild, and the chance to move straight up in your profession.

Consider, too, the added advantages of living and working close to Baltimore and Washington, in the attractive Cumberland Valley, where housing, schools and recreational facilities are among the nation's finest. And, Fairchild's salary plan, paid pensions, health, hospitalization and life insurance benefits give you extra security in which to build your future.

Send a detailed resume of your experience to Walter Tydon, Chief Engineer. All correspondence will be kept in strictest confidence, of course.

"where the future is measured in light-years"

ENGINE AND AIRPLANE CORPORATION
FAIRCHILD
Aircraft Division
HAGERSTOWN, MARYLAND

Sections

Continued from page 98

ber has been essential.

The success of any SAE Section or Group depends largely upon the ability of the governing board to maintain membership interest at a high level. Providing program material of sufficient appeal to lure members to meetings is one of the best ways to maintain this interest. Hawaii's location in the middle of the Pacific is a definite hurdle in this respect. But, alertness and initiative on the part of all the members does the trick.

Local papers are watched carefully for mention of possible speakers. Publicity directors of the airlines serving the territory are contacted for news of visitors to the islands. Local business concerns are asked to help. The Armed Services are approached and have done an outstanding job for the Section.

Dinner meetings are held on the grounds of local concerns. This way a tour can be combined with a dinner speaker. And the members find the novel atmosphere attractive.

A highlight of the Section year is the visit by our SAE President. Each group turns out in large numbers to welcome him and hear his talk. Dr. Rosen particularly enjoyed his stay as the photos on page 88 show.

The resulting interesting programs are the product of combined effort. This is made even more evident by the fact that the Section is necessarily divided into three parts, each on a separate island. The central office of the Section is located in Honolulu, while separate divisions meet on Maui and Hilo.

If you know of anyone visiting the islands who might serve as a speaker for one of the meetings, let the Section know. You will be helping a Section that faces unusual obstacles.

BUFFALO

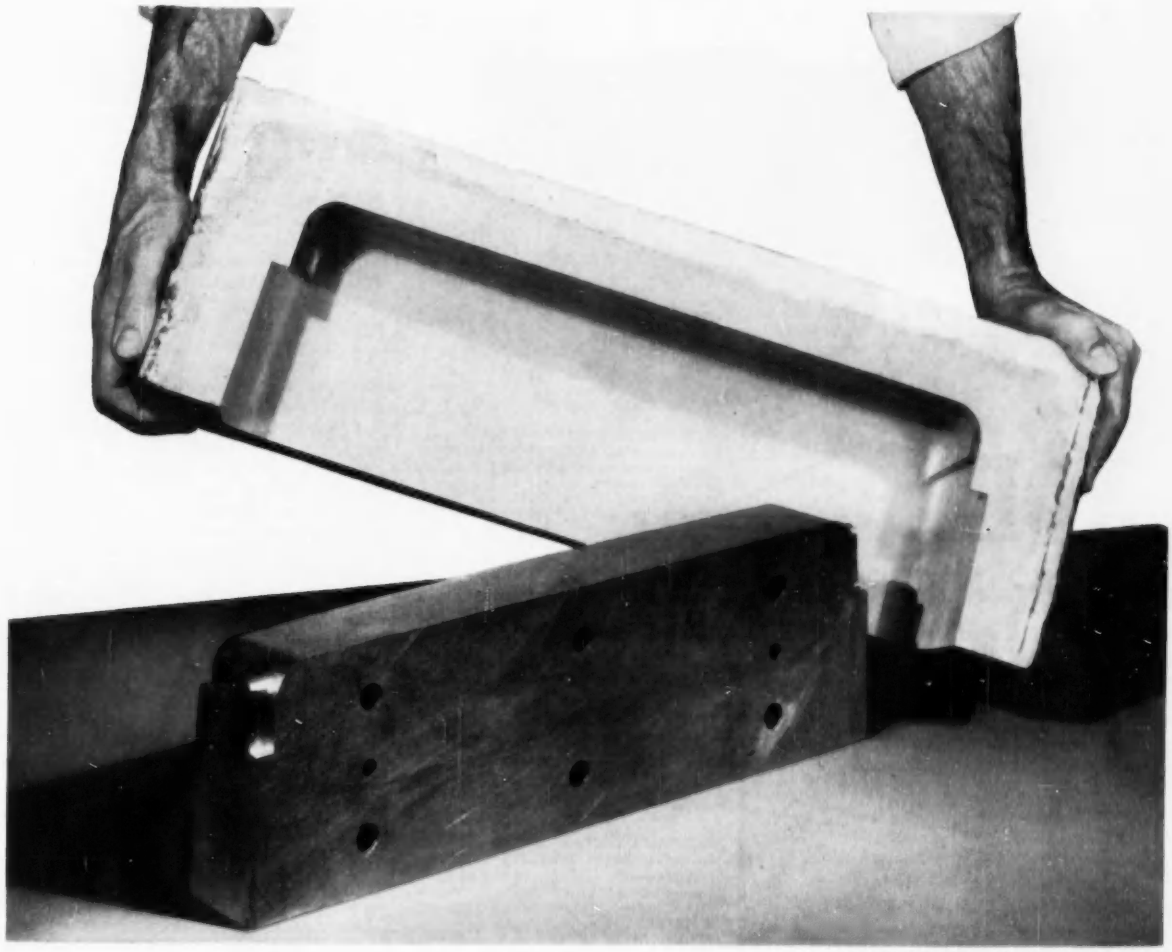
Dudley Losee, Field Editor

Members Are Key To Meetings' Success

—Dudley Losee

Section members themselves are the key to a successful program of Section meetings. A Section Program Committee needs that key to open the door on a new Section year.

Buffalo shapes that key by getting its membership each year to indicate in advance the topics most desired. The Governing Board gets this information by enclosing with each year's ballots a



"Rezolin" Toolplastik Compound forms the concave die model shown here with the machined aluminum model around which it was cast. A "Keller" duplicator will be used to reproduce the plastic model in steel. This method saves five days, with an estimated 25 per cent reduction in production costs. Based on BAKELITE Epoxy Resins, this tooling compound is produced by **Rezolin, Inc., Los Angeles 25, Calif.**

Cast epoxy "Keller" Model shapes up 25% saving

Savings in toolmaking time often reach impressive percentages when compounds based on BAKELITE Brand Epoxy Resins are used. Here are some of the reasons:

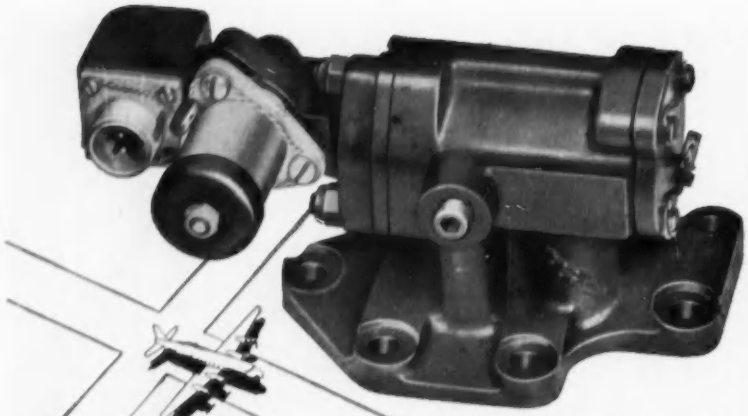
- **Liquid compounds—can be cast to shape without pressure**
- **Cured at room temperature—no applied heat**
- **Minimum shrinkage—minimum finishing**
- **Excellent flexural, compression, and impact strength**
- **Outstanding dimensional stability**
- **Light weight means easy handling**
- **Laminated with glass cloth to form jigs, spotting racks, fixtures, and "Keller" models.**

For further information, write Dept. LO-170.

BAKELITE
BRAND
Epoxy Resins for Tooling

BAKELITE COMPANY, *A Division of Union Carbide and Carbon Corporation* UCC 30 East 42nd Street, New York 17, N.Y.

The term BAKELITE and the Trefoil Symbol are registered trade-marks of UCC



24730 BLOWER CLUTCH SELECTOR VALVE
For use on Pratt & Whitney R-2800 engine.
Controls operation of two-speed supercharger. Electrical control is positive in action. Current failure returns valve to normal position, placing supercharger in low gear.
Weight: 2.2 lb.

ADEL

ENGINE ACCESSORIES

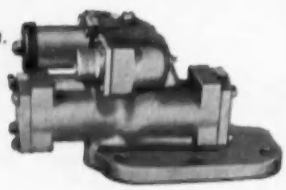
Precision-Built . . . Performance-Proved . . .

USED BY MAJOR AIRLINES AND AIRFRAME MANUFACTURERS

Valves and actuators you can specify with confidence. Provide fail-safe operation in case of electrical failure. Light weight.

Operating fluid: Engine Oil.
Duty: Continuous.
Solenoid: Single-coil, internally grounded.
Electrical Range: 18 to 30 volts dc.
Current drain: 0.5 amp at 24 volts.
Corrosion resistant construction.

24793 SUPERCHARGER CONTROL ACTUATOR
For use on Wright R3350-30 engine.
Provides positive control of two-speed supercharger with complete immunity to pressure surges in the operating fluid. Durable and dependable.
Weight: 1.75 lb.



26153 SUPERCHARGER CONTROL VALVE
For use on Pratt & Whitney R4360-63 engine.
Directs oil flow from pressure supply to high blower. Rated flow—9 gpm.
Built-in stamina provides dependable performance under extreme vibration conditions.
Weight: 1.9 lb.

25805 SUPERCHARGER ACTUATOR
For use on Wright R1820-103 engine.
Converts hydraulic pressure to mechanical push-pull actuation. Electrically controlled. Combines reliable operation with proven design . . . rugged construction.
Weight: 1.95 lb.

ADEL produces a complete line of Aircraft HYDRAULIC & PNEUMATIC CONTROL EQUIPMENT, HEATER, ANTI-ICING & FUEL SYSTEM EQUIPMENT, ENGINE ACCESSORIES AND LINE SUPPORTS.

DIVISION OF GENERAL METALS CORPORATION • BURBANK, CALIF. • HUNTINGTON, W. VA.

CANADIAN REPRESENTATIVE: RAILWAY & POWER ENGINEERING CORPORATION, LIMITED

Sections

Continued from page 100

list of suggested topics for meetings.

On this list, each member is asked to show in numerical order the subjects in which he is most interested—and to add other subjects, if he wishes. Results of this poll are tabulated in a manner similar to a coach's football or basketball poll. With this poll as a key, the Governing Board develops a program of interest to a majority of the Section's membership.

Procurement of the speakers and organization of each meeting is turned over to a Meeting chairman for each meeting, who is usually a Program Committee member. In most instances, the Meeting chairman is closely associated with the subject, and is acquainted with the person or persons who could help to make his meeting worthwhile. The completed program is presented to the members prior to the first meeting in the fall.

All elements of the Section actively participate in the programming. One or two meetings a year take place within each area of influence. The Program Committee chairman must assist and coordinate with the actions of the Meeting chairmen in order to insure smooth running meetings.

The Buffalo Section has learned that all meetings cannot be speaker meetings. Therefore, Section programs include speakers, narrated movies, joint meetings of Activity divisions, plant trips, and a ladies' night. Varied types of meetings, membership participation in planning and advance planning provide the stimuli to keep the membership interested in all activities of the Section.

New England

George T. Brown, Field Editor

Special Tribute Paid to Glenn S. Whitham

—G. T. Brown

Glenn S. Whitham has been dubbed "Honorary Chairman" by New England Section. The title celebrates 40 years of continual service to SAE and New England Section.

This tribute was paid to Whitham at the recent annual New England Summer Outing, a very appropriate time, since Whitham has given many a busy hour to the success of this summer highlight for twenty-five years.

SAE gained this dedicated member back in 1915 when the Society still was known as the Society of Automobile Engineers. The Section has him on its

ANOTHER UNSEEN IN AUTOMOTIVE DESIGN . . .

The highly dramatic results which have followed adoption of tubular push rods now can be translated into noteworthy accomplishments. Smoother, smarter engine acceleration is immediately apparent, while dynamometer tests reveal an increase of 200 to 300 additional r.p.m., to insure an increased horsepower in excess of 5%.

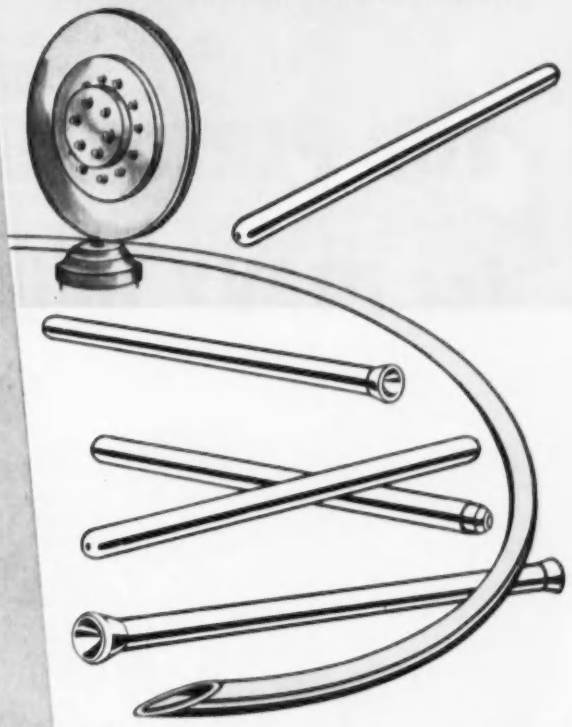
Supplanting solid push rods with lighter, thin wall Fusionweld steel tubing proved highly satisfactory. This tubing is now being used by several motor car manufacturers with excellent results. Avon Fusionweld is designed to match the most rigid automotive specifications, meet the most exacting tests for a fatigue resistant product and insure those essentials of greater tensile strength and superior ductility for even the most difficult forming operations.

Avon's exclusive method of high cycle resistance type welding, combined with a die sinking process of cold drawing helps insure a tubing with a completely homogenous grain structure in both wall and weld. This new technology offers much greater resistance to fatigue, increases ductility, provides exceptional toughness and successfully eliminates the possible occurence of tubing defects at the time of drawing.

3/16" O.D. to 3/4" O.D.
PLAIN OR TERNE COATED

Fusionweld

TUBULAR PUSH RODS



Special straightening equipment installed by Avon guarantees tube concentricity and minimum of run-out. Newly developed automatic assembly and indexing machines assure accurately located and spot welded hardened steel inserts. Still another Avon development provides a most essential quality controlled cold heading process for special swaged end push rod designs. Both methods serve to reduce tubular push rod fabrication costs to a new low.

Our current catalog on thin-wall Fusionweld Steel Tubing is available on request.

Numerous automotive applications of Fusionweld Steel Tubing are now being served, including brake lines, hydraulic and vacuum lines, dip stick tubes, radiator overflow tubes, lubricating lines, etc.

AVON TUBE DIVISION
HIGBIE MANUFACTURING CO.
ROCHESTER • MICHIGAN

Sections

Continued from page 102

list of charter members. It also has him on its list of past officers many times. He has served as assistant secretary, secretary, vice-chairman, and chairman. During his term as chairman in 1926–1927, New England Section was host to its first national meeting. The Transportation and

Whitham

Maintenance Activity held its meeting in the then Copley Plaza Hotel in October of 1926.

On the side, Whitham found time to serve on many committees. For instance, he was very active on the nominating and passenger car committee work.

TEXAS

R. N. Jones, Field Editor

SAE Student Branch at **SOUTHERN METHODIST UNIVERSITY** has inaugurated a unique "Know Your Faculty Program." It's designed to let the students know the faculty as individuals as well as teachers.

Each month on the bulletin board is posted the photograph and a personalized biography of another faculty mem-

ber. In the accompanying picture, Virgil Bullard, B-Section vice-chairman of the SAE Student Branch is posting the story of Earl H. Flath, Dean of the School of Engineering. It tells of the dean's hobbies, personal background, and engineering interests.

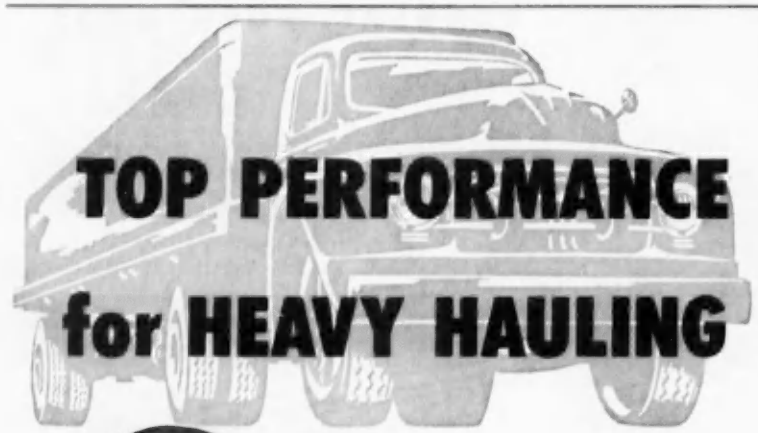
(The "B-Section" designation in Bullard's title stems from fact that SMU engineering students are alternately in school for 8 weeks; then work in industry for 8 weeks. Freshmen are only ones who go to school steadily for about 12 months. Then they go co-op too.)

Central Illinois

Harlan Banister, Field Editor

CENTRAL ILLINOIS has just appointed its first Reception Committee. Newly formed, with D. W. Knopf as chairman, it aims "to fulfill a recognized need for better sociability at Section meetings."

CENTRAL ILLINOIS will have nearly 150 of its members actively participating in Sections work during the 1955–56 year. More than 60 members



TOP PERFORMANCE for HEAVY HAULING

BORG AND BECK "E" TYPE CLUTCH

- Husky—Heavy Duty
- "Strap Drive"
- Friction-Free
- Smooth Engagement
- Minimum Maintenance

Engineered by BORG & BECK

for that vital spot where power takes hold of the load

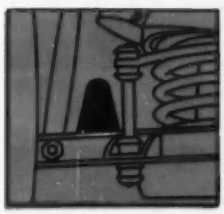
ENGINEERING B-W PRODUCTION

BORG & BECK DIVISION

BORG-WARNER CORPORATION • CHICAGO 38, ILLINOIS

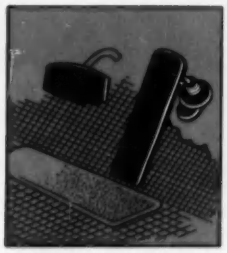
In over 100 places, Enjay Butyl rubber parts

add to Pontiac performance



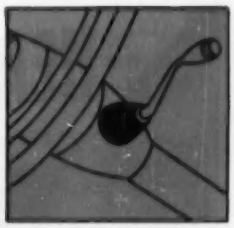
Axle bumper

Body seals, gaskets, insulators, pads, grommets, etc.



Brake and accelerator pedal pads, bellows

Radiator and heater hoses, ducts



Gearshift lever cover

Pontiac has been using parts made of Enjay Butyl since 1946. The great '56 model now incorporates more than 100 parts made from this super-durable rubber, adding to its performance, style and value. These parts have amazing resistance to deterioration and will easily last the life of the car.

Among the many advantages of Enjay Butyl are *price* and *ready availability*. And it is now available in non-staining grades for white and light-colored parts. Extensive laboratory and testing facilities are at your service. For the full story, contact the Enjay Company today.

ENJAY BUTYL

Enjay Butyl is the super-durable rubber with *outstanding* resistance to aging • abrasion • tear • chipping • cracking • ozone and corona • chemicals • gases • heat • cold • sunlight • moisture

ENJAY **ENJAY COMPANY, INC.,** 15 West 51st Street, New York 19, N. Y.
District Office: 11 South Portage Path, Akron 3, Ohio

35 SUCCESSFUL YEARS OF LEADERSHIP IN SERVING INDUSTRY

Sections

Continued from page 104

are working in regular committee assignments. Some 50 to 60 more will be sparking and handling next year's Earthmoving Industry Conference—the great two-day Section-sponsored meeting which last year drew an attendance of nearly 1200. Total CI membership is now about 325, making the committee-active members 46% of the total.

So. California

W. E. Achor, Field Editor

SC Governing Board plans to have all information for meetings notices written up and in the hands of Secretary Paul Garver for processing at least *four weeks* before each meeting.

A copy of the paper to be presented should also be received by that time, it is believed.

SC Governing Board is urging each of its major committee chairmen to have an assistant . . . and to make certain that either the chairman himself or his assistant be present at each GB meeting.

PITTSBURGH

W. C. Weltman, Jr., Field Editor

Varied Interests Dictate a Varied Program

—W. C. Weltman, Jr.

Serving a district closely associated with the automotive industry, but not concerned with producing automotive equipment, is the problem of the Pittsburgh Section of SAE. Pittsburgh has basic material suppliers (steel, aluminum, glass, fuels, and lubricants) and consumers such as utility and commercial trucking fleets.

Highly technical and theoretical papers draw less response than those which deal directly with materials and equipment applications.

To cover these varied interests, the Pittsburgh Section Governing Board attempts to have an automotive engine paper, a fuels or lubricants paper, and a metals paper during each section year. This program has been well received.

So. New England

S. L. Leavitt, Field Editor

YALE UNIVERSITY Student Branch has approved a program for coming meetings. Supplementary movies on topics of general interest have been added to the year's program. Professor Herbert W. Best of the School of Engineering at Yale will be serving as faculty advisor.

Texas Gulf Coast

Student Branch membership at TEXAS A&M has now reached 56. This was announced at the Oct. 7 meeting when the Branch was host to Texas Gulf Coast Section. The meeting was held in the Memorial Student Center on the college campus.

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E. H. HEINEMANN
Chief Engineer, El Segundo Division
Douglas Aircraft Company, Inc.

"It is extremely important that designer, equipment manufacturers, and procuring agencies all have a clear understanding of the relationship between weight-saving and manufacturing costs. While the factor that relates cost to weight varies somewhat for different components and from one manufacturer to another, it has been found in recent years that on the average a pound of weight costs $50 to develop and produce. When this factor is combined with a typical weight growth factor of ten, *the cost of one pound of extra weight amounts to $500 per airplane if performance and strength are to be maintained.* From these figures it can be seen that there is ample justification for the expenditure of engineering time on all phases of a weight-saving program, no matter how small the individual saving may seem."

—E. H. HEINEMANN

at SAE National Aeronautic Meeting, Los Angeles

This growth factor discussed by Mr. Heinemann makes excess weight costly indeed. At $500 per pound, it literally costs its weight in gold. (Gold at $35 per troy ounce is worth $510.30 per avoirdupois pound.)

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Special impregnation makes it unusually compact. Eliminated is the bulky insulation between turns common to other high-temperature units of this type. This impregnation also makes the coil impervious to salt spray and fungus. Design data includes:

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JACK & HEINTZ Rotomotive AIRCRAFT EQUIPMENT

About SAE Members

Continued from page 81

ANDREW W. ZMUDA is now director of research for The DeVilbiss Co., Toledo. He was chief engineer, Houdaille-Hershey Corp., Buffalo, N. Y., Division.

JOHN J. DORWIN has become sales promotion manager, The Oliver Corp., Charles City, Iowa. He was chief engineer for the company's Aviation Division, Battle Creek, Mich.

T. C. FETTERMAN is with the Bakelite Co., Cincinnati, as technical representative in the Surface Coatings Material Division. He was technical representative for the company in Chicago.

FRED T. WEISMAN, formerly engineer for Westinghouse Electric Corp., Kansas City, Mo., is now power plant engineer for Trans World Airlines, Inc. in Kansas City.

WILLIAM F. COLLINS is now the owner of Collins Implement Co., Toulon, Ill. He was previously chief engineer, International Harvester Co., Chicago. His company handles International Harvester products.

KEITH E. COXE has joined Lockheed Aircraft Corp., Burbank, Calif., as design engineer. Coxe was designer for Machine & Tool Design Co., Baltimore.

RUSSEL H. NUTTER is with the Pittsburgh Steel Products Co., Detroit, as materials handling engineer. Previously he was sales manager, Detroit office, Faultless Caster Corp.

RAUL A. STERN, formerly research assistant at the University of Wisconsin, Madison, Wis., is a student at the University of California, Berkeley, Calif.

BERNARD GOLDMAN has been appointed liaison engineer and Maxwell Bernson publications department editor at the Ford Instrument Co., Division of Sperry Rand Corp., Long Island City, N. Y. He will represent the firm on U. S. Navy Bureau of Aeronautics contracts. He was engineer-writer in the publications department of the company.

OTTO K. LeBRON, formerly city manager, Hertz Stations, Inc., Philadelphia, is vice-president, Hertz Corp., Chicago.

JAMES MILLER, who had been lieutenant, junior grade, U. S. Navy, is now enrolled at the Graduate School of Business and Public Administration, Cornell University, Ithaca, N. Y. He is studying to obtain a Master's degree.

T. A. HALLER has been appointed vice-president, director of engineering and research, for the American Tractor Corp., Churubusco (Fort Wayne), Ind. He was assistant chief engineer, Allis-Chalmers Mfg. Co., Springfield, Ill.

CHARLES E. WEBB has become zone service manager for the General Motors Corp. Truck and Coach Division's Seattle zone. He was zone service representative and instructor at the General Motors Training Center, Tigard, Ore.

DANIEL STERN has joined the Naval Ordnance Laboratory Staff, Whiteoak, Md., as mechanical engineer. He was in the U. S. Army.

CARL H. BOAS is now associated with Schick, Inc., Lancaster, Pa. He is research engineer and physicist in the design and development section, working on intricate electro-mechanical mechanisms. He had been with Altem Research Laboratories and Engineering Co., Mt. Penn, Reading, Pa.

ANDREW G. WYRICK, previously chief draftsman, Servel, Inc., Evansville, Ind., is manager of engineering standards and procedures, Whirlpool-Seeger Corp., St. Joseph, Mich.

DON PRESTON has become chief engineer, Acme Appliance Mfg. Co., Pasadena, Calif. He had been with the Wiggins Oil Tool Co., Los Angeles, as installation engineer.

DAVID W. KNOLL, previously lieutenant, junior grade, Department of the Navy, U.S.S. Mathews, is now with the Battelle Memorial Institute, Columbus, Ohio.

SP News About Special Publications

COLD FACTS ON THE HOTTEST ISSUE to confront the automobile industry in many years—**FUEL INJECTION**—will soon be available. Will fuel injection replace carburetors? If so, when? These questions are discussed in five papers presented at a Fuel Injection Symposium during the Detroit Section Meeting in White Sulphur Springs, West Virginia, Sept. 9. Papers will be sold in package form. Price and date of availability will be announced later. Watch for it!

HELP YOURSELF TO HELPFUL INFORMATION by getting reprints of sections from the SAE 1955 SAE Handbook which you refer to frequently. These easy-to-carry, easy-to-use booklets are especially handy in the shop. Write to SAE Special Publications Department for:

- **SP-30 SAE Iron and Steel Standards and Specifications** This booklet includes all the ferrous metal information that is in the 1955 Handbook. Price: $3.00 to members, $6.00 to nonmembers.
- **SP-33 Electrical Equipment** This booklet contains all standards on electrical equipment except lighting. Price: $1.00 to members, $2.00 to nonmembers.
- **SP-34 Lighting Equipment and Photometric Tests** This booklet contains all lighting reports. Price: 75¢ to members, $1.50 to nonmembers.

Prices on the above booklets are lower when ordered in quantity.

NEW, REVISED, SECOND EDITION OF SAE AUTOMOTIVE DRAFTING STANDARDS will be available by Dec. 1. This latest issue will contain revisions in the **Screw Thread** section. Also, an ordinate chart for True Sweeps has been added to the **Placement of Body Draft Views** section.

These standards are prepared for instant insertion in the standard three-ring binder. Price: $6.00 per copy to SAE members and nonmembers. Prices are lower for quantity orders.

New Members Qualified

These applicants qualified for admission to the Society between Sept. 10, 1955 and Oct. 10, 1955. Grades of membership are: (M) Member; (A) Associate; (J) Junior.

Alberta Group

Andrew W. Peterson (J).

Baltimore Section

Donald Resch (J), George W. Westphal (M).

British Columbia Section

Hugh John Kippan (M), Jack Nelson (A).

Canadian Section

Albert E. Collins (M), William P. Gent (A), Karol J. M. Godlewski (M), Nicholas Gritzuk (M), John A. McGiffin (J), Robert S. Norminton (M), Samuel Schacter (A), Fred C. Walter (A), Harold F. Young (M).

Central Illinois Section

William E. Budd (J), John Gilbert Wellwood (J).

Chicago Section

Stephen S. Baits (M), Dwight L. Barr (J), Norris E. Caudell (J), Wallace J. Costenaro (A), Wendell E. Eldred (M), Norman L. Ginder (M), Joseph J. Gray (M), Leo F. Hayer (M), James S. Hurrell (J), Frank E. Kalivoda, Jr. (J), Carl A. Loy (J), John W. Moules (J), Vincent P. Reilly (M), Frank E. Rollent (M), Martin G. Sachs (J), Thaddeus J. Sawa (J), Albert H. Scherer (M), Murray D. Scott (A), Alvin E. Shugarman (M), Ben D. Smith (M), John L. Springer, Jr. (M), Paul B. Stephens (J), Charles H. Sutton (A), George Taylor (M), William R. Walker (M).

Cincinnati Section

Robert L. Grunewald (M), Harold G. Houlton (M), Clarence R. Wuellner (J).

Cleveland Section

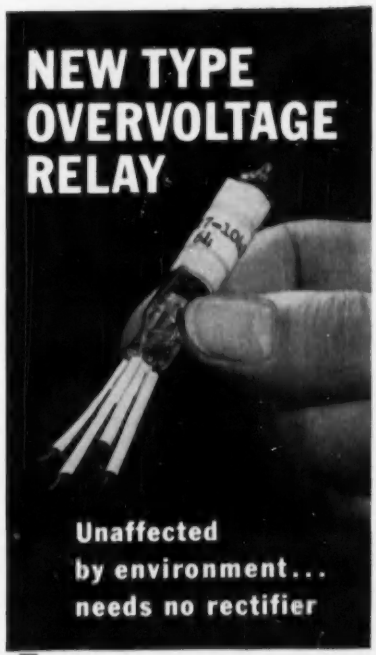
Julius Barat (J), Mathew D. Baratko (J), Daniel P. Barnard, 5th (M), James L. Baxter (M), Walter J. Fifer (A), Charles J. Gervason (M), Michael J. Halaiko (M), George V. B. Hall (J), James B. Hoffman (J), J. Robert Jameson (M), Edwin C. Marzinzik (A), Logan Ross (M), Horace A. Shepard (M), Frank G. Steinebach (A), Harry Ed Taber (A), Harold E. Wick (M).

Dayton Section

David R. Fleming (M), Paul F. Joseph (M), Allan U. Macartney (J).

Detroit Section

William E. Adams (J), Robert J. Allen (J), Donald W. Beane (M), Frank P. Biondo (M), George E. Bisbee (A), James W. Bohlander (J), Stefan P.



Easy adjustment to desired voltage limits, long life, reliability and simplicity are other features incorporated in this J&H overvoltage relay for aircraft. While designed primarily for J&H a-c control panels, it works equally well on any a-c system or control panel.

This "glow switch" relay offers the following improvements over present overvoltage relay circuitry:

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New Members Qualified

continued

Boran (A), Nelson R. Brown (A), Jack A. Bush (M), Gordon L. Buyck (J), Maurice B. Calfin (J), James E. Colbert (A), Albert S. Colinas (A), James T. Congelliere (J), Richard L. Courtney (J), Richard R. Crandall (J), Ralph Emerson Cross (M), Edmund Charles Decker, Jr. (J), Frederick R. Dennison (M), John D. Dietiker (M), Joseph A. Drankowski (M), Leonard A. Dreisbach (M), Joseph Paul Eastman (M), George C. Forsyth, Jr. (J), Burr J. French (A), Edwin S. Getner (J), Robert O. Gibson (A), Don D. Goodsell (A), Richard M. Graham (M), Richard A. Gustafson (J), Finn T. Halbo (J), Donald R. Hannum (J), Donald J. Hawk (J), John E. Herrold (A), Douglas C. Hewitt (J), Edmund M. Hilton (J), Carl Edmund Kime (J), Frederick C. Koch (M), Yun-Ting Kwan (J), E. Kendrick Leavenworth (M), Denis L. Lenane (J), Gerald R. McCloskey (J), Gordon A. Meyers (A), Richard T. Noe (M), Gilbert D. Pierron (M), Lawrence E. Podnar (J), B. F. Poffenberger (M), William E. Reinsel (J), James S. Rodgers (M), Henry J. Roesch, Jr. (J), Joseph A. Sember (M), Leo Edward Siess (M), Paul S. Silber (J), Carl Smereck (M), George E. Spaulding, Jr. (M), Carl F. Stieler (J), Oliver P. Swope, Jr. (M), Richard E. Truesdell (A), Robert H. Vorech (A), Victor S. Warren (M), Richard B. Watson (A), William E. Widmaier (M), Warren D. Wolcott (M), Robert W. Wolverton (A), Julian John Woytowich (J), Leon Zontek (A).

Hawaii Section

James L. Shetterly (A), Edwin K. Stearns (A).

Indiana Section

Thomas F. Bernhardt (J), Major Preston Cornett (J), John H. Letsinger (M), Marshall F. Reehling (A), Mrs. Jane Sundling (A).

Kansas City Section

Gale M. Baker (M), Floyd H. Norriss (M), Sidney C. Palmer (M).

Metropolitan Section

Vincent Cerullo (A), Walter R. Haldeman (M), Peter J. Hart (J), Arthur R. Heydorn (A), Robert B. Kaplan (J), Herbert Charles Kiesling (J), Alfred J. Kinn (J), Bert Lampe (J), George F. Lohr (J), Charles Milak (A), Mundy I. Peale (M), Lt. Warren C. Reynolds (J), Robert A. Schmicker (M), Richard A. Sorenson (A), Eugene P. Valley (J).

Mid-Continent Section

Edwin A. Neugass (M), Robert Paul Stuart (M), Edward H. Toomey (M), Paul D. Williams (M).

Mid-Michigan Section

Richard V. Gidner (J), John W. Gustke (J), Robert J. Johnson (J), Clayton W. McPhee (A), Lester E. Patterson (J), Eldridge W. Reese (A).

Milwaukee Section

Royce N. Brown (J), Richard Luedtke (J), John N. Moore (M), Jack L. Morgan (M), Robert E. Rohde (A).

Montreal Section

Stanley C. McRobert (J), Charles F. Russell (M), Maurice J. Stevenson (M).

New England Section

Edward E. Burritt, Jr. (A), William Gaston Gove (J), Bruce P. Hoffman (J), William Jeuick (M), Robert M. Oppenheimer (M).

Northern California Section

Haig Asdurian (J), Edward R. Howard (A), Charles H. Johnson (M), C. Dean Newnan (M), George M. Zambon (A).

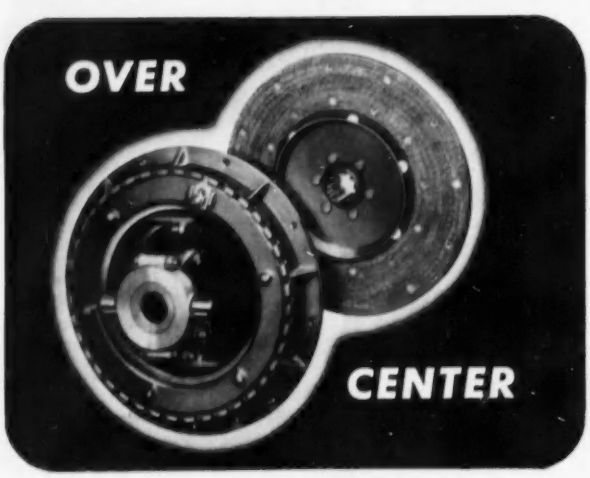
Northwest Section

Donald H. Niesse (J), Harold C. Varney (A).

Oregon Section

James W. Tanner (M).

ROCKFORD



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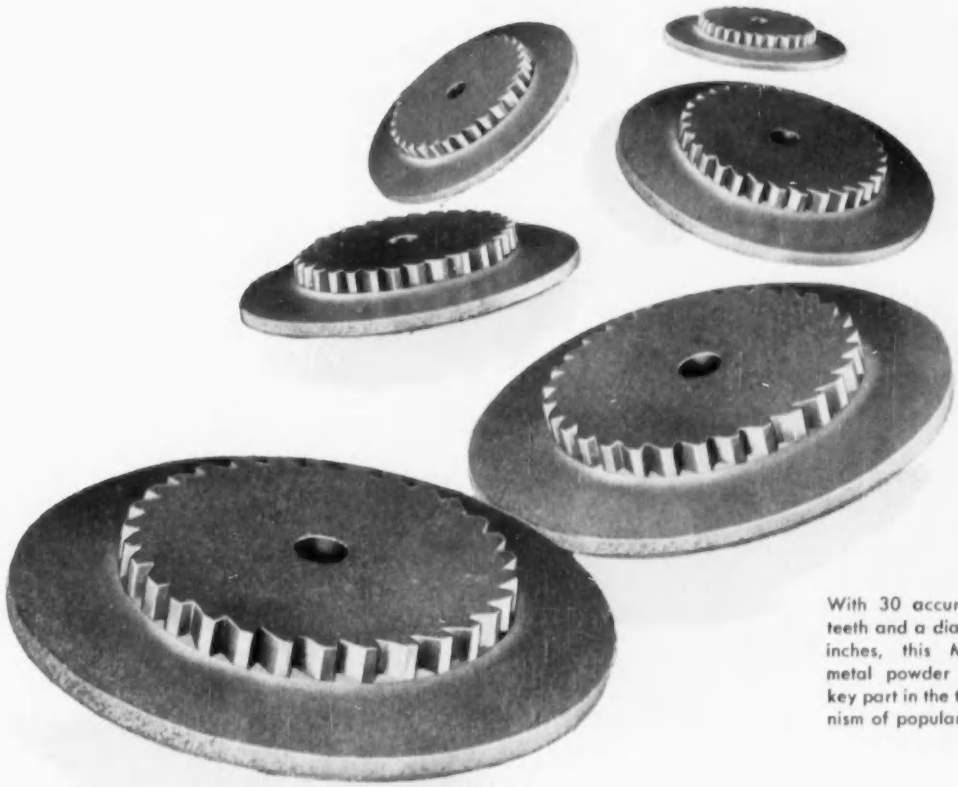

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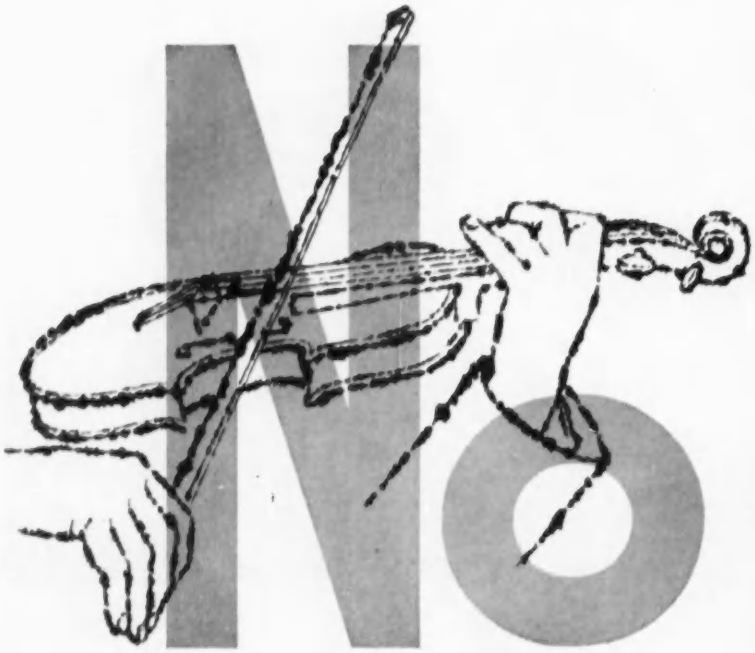

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New Members Qualified

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Philadelphia Section

Robert P. Burns (J), John D. Miller (J).

Pittsburgh Section

Robert C. Eazor (J), Ludwick J. Perman (J).

St. Louis Section

John T. McFarland, Jr. (J), Gerald J. Schmidt (J).

Salt Lake Group

John C. Bates (M).

San Diego Section

Richard L. Andre (J), Louie A. Cappello (M), Raymond C. Sebold (M), Stanley G. Thomas (J).

Southern California Section

Ensign Roger C. Bascom, Jr. (J), Donald R. Brincka (J), John P. Cannon (M), Herbert A. De Cenzo (M), Mitchell B. Haisten (M), Jack Edward Henry (M), Ronald E. Lewis (J), Henry Grady Marshall (M), Stanley F. Parkill (J), Jack Sinder (M), James Clyde Spracher (J), Richard E. Tisch (M), Tatsuo W. Tsukahira (J), Clarence Waltner, Jr. (J).

Southern New England Section

Charles E. Bodemann, Jr. (J), Frederick W. Gilbert (J), James H. Patrie (J).

Spokane-Intermountain Section

Carl O. Tangen (A).

Texas Gulf Coast Section

Robert E. Engelhardt (J).

Twin City Section

Carlos A. Claure (J), Jerome L. Lorenz (J), Wayne H. Mac Farlane (M), Douglas M. Skoglund (J), David Lee Turner (J).

Virginia Section

Charles J. Gaetz (J), Walter F. Harris (A).

Washington Section

Thomas T. Hinman (M).

Williamsport Group

Ronald Kolenkiewicz (J).

Outside Section Territory

John D. Lewis (J), Harvey G. Patterson (J), Joseph H. Pereue (A), Richard H. Zeder (J).

Foreign

L. G. Boehner (M), Germany; Raymond E. Donough (A), Borneo; Hein-

rich Nordhoff (M), Germany; Leonard A. Paterson (M), England; John E. Shepherd (M), England; Torsten R. Verkkola (M), Finland.

Applications Received

The applications for membership received between Sept. 10, 1955 and Oct. 10, 1955 are listed below.

Atlanta Section

Robert F. Stoessel, H. T. E. Tollett, Jr.

Baltimore Section

David Caster, Richard L. Colgan.

Buffalo Section

Gale H. Buzzard, II, Roy W. DeWitte, Johannes M. A. Van der Horst.

Canadian Section

David H. Connell, Ronald M. Davies, Alfred E. Derumaux, J. L. Forster, Ernests Groskopfs, Franciszek Kresowski, George G. Macenko, James C. Richardson, Harvey R. Smith, John A. Taylor.

Central Illinois Section

J. C. Bollier, Robert C. Brown, Lester D. Bergsten, Don M. Dinquel, Wilbur L. Hertenstein, Charles R. Hudson, William C. Jarvis, Carl R. Maxwell, Kenneth L. Schafer, William C. Schreiner, James W. Voth, Dale J. Wright.

Chicago Section

Joseph F. Bakel, John K. Buttfield, John A. Carlson, E. A. Domes, Jr., Charlie N. French, G. Robert Harting, John E. Kelly, John A. Laser, William A. Leeper, David C. McVey, William W. Nugent, James J. O'Sullivan, D. L. Ries.

Cincinnati Section

J. Douglas Delano, Jr., Bruce L. McMillan, James R. Sheets.

Cleveland Section

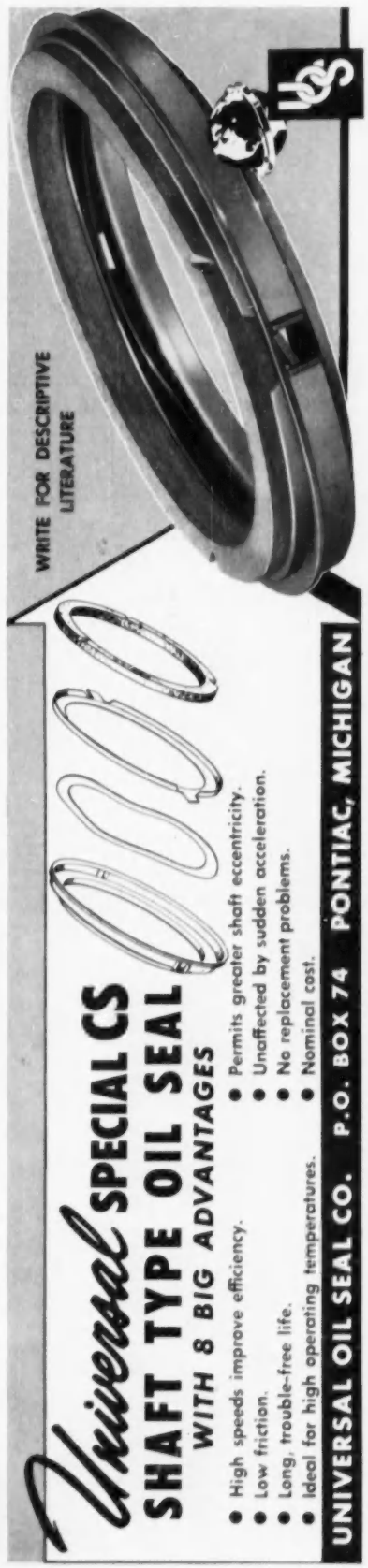
William D. Adams, Albert W. Cook, J. N. Crawford, Robert B. Fell, Dean C. Reemsnyder, Ralph A. Schaefer, Charles B. Small, Kenneth C. Wessel.

Colorado Group

Robert R. Atchison.

Dayton Section

Robert E. Beauregard, Walter C. Klank, Jr., Richard E. Rinearson, Clare R. Weaver.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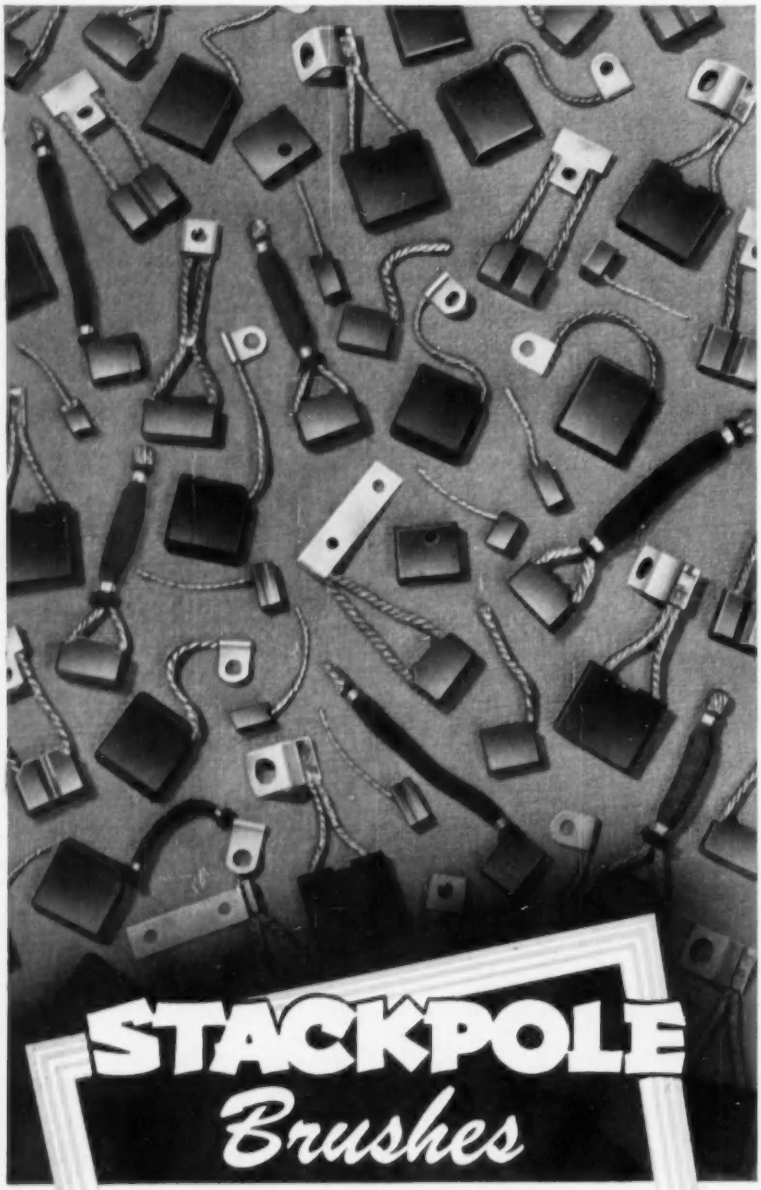

Applications Received

continued

Detroit Section

Frederick C. Aebersold, Roger L. Aldrich, George E. Altmansberger, Gustav E. Autenrieth, Robert Lorne Ayers, Richard C. Bahnmiller, Arthur B. Bailey, Warren M. Beevers, John M. Berndtson, Stanley Bonzack, William C. Bright, Jr., Alfred T. Bryant, James D. Buescher, John R. Burrell, Jr., Donald A. Caley, J. H. Campbell, Richard J. Crane, Theodore DeBoer, Walter S. DeWolf, Edward Eames Donaldson, John M. Downing, Donald P. Duclos, William J. English, Jr., Chester W. Everts, Garry T. Fortune, Vincent E. Gardner, Donald E. Gauthier, Thomas L. Geiger, Gordon T. Getsinger, Gilford E. Gorker, Charl E. Greene, James J. Gumbleton, LeRoy C. Guthrie, L. R. Hafstad, Leonard A. Hamel, Herbert F. Hames, Kai H. Hansen, Joachim Herz, Louis W. Huellmantel, Franklin N. Jenkins, Jr., C. S. Johnson, Henry J. Keane, Norman R. Keck, John J. Killinger, Ronald S. Knowles, John Koinis, Allan Kornmiller, William Krass, William S. Kristofetz, William S. LaFayette, Kenneth R. Lane, Savas Laskarides, Robert J. Lechner, Ervin C. Lentz, Jr., Eino A. Leppiaho, Richard L. Levenick, Richard C. Lewis, Gary S. Long, Warren J. Lotz, Eli R. Lupin, Charles E. Luxmoore, Donald J. MacIntosh. Robert F. McKown, James Patrick Meloche, W. Mitchell Middleton, Joseph Mlinaz, Richard L. Myers, William U. Nelson, Richard L. Nietert, John Nixon, Henry K. Nowak, Paul D. O'Brien, George N. Payne, Robert L. Pence, William F. Peschel, Leonard J. Piconke, Irving L. Pierce, Robert C. Redford, Robert J. Regenhardt, Edward L. Richardson, John M. Robertson, Franklin H. Schafer, William R. Slattery, Donald J. Smith, Robert H. Smith, Ray W. Springer, Jr., Joseph E. Stoyack, Jr., William C. Strom, William W. Swank, James Thomas, Robert M. Thompson, Jr., Jay W. Thornburgh, Herbert Oskar Tieva, Edmund Towers, Alverson B. Williams, Philip James Willson, Richard A. Wilson, Michael H. Wolfbauer, Jr., W. B. Wollard.

Hawaii Section

George K. Sereno.

Indiana Section

Ralph Bancroft-Billings, Thomas W. Binford, Charles E. Cook, Harry Fackenthal, Ronald S. Harrelson, Thomas F. Havens, Angelo S. Miceli, Robert W. Sewall, Glen Alan Smith.

Kansas City Section

L. Wayne Beal, David W. Berry.

Metropolitan Section

James V. Carideo, Louis C. Dagne, Nick H. Devletoglou, Harry Dornbrand,

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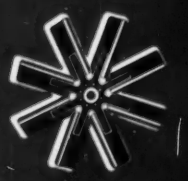
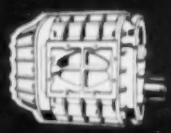


Fans

Turbochargers

Dampers



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Schwitzer has extensive Research and Engineering facilities and experienced technicians to develop an economical product—for the Flow of Air, Oil, Water and other Fluids—or the Isolation or Elimination of Vibration in your equipment, whether it is in the Automotive, Atomic, Aircraft, Agricultural, Earth Moving, or other fields.

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LISLE Magnetic PLUGS
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Write for FREE Sample Plug for Testing
State size and type of Lisle Plug desired.
LISLE Corporation
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Applications Received

continued

Victor Pascal Goldring, Walter A. Herbst, Robert P. Irwin, Kenneth V. Ludlum, Edward Melinsky, Curtis B. Morehouse, Larry Mozzar, David C. Nyenhouse, Lawrence E. Putnam, Joseph A. Sanfilippo, Irwin Saretsky, Henry Waller, Herbert A. Whitney, Paul K. Wilson.

Mid-Continent Section

Robert N. Collins, C. M. Gordon, Jr., Nicholas Ignatovich, Jack C. McGuire, Bennie Shultz.

Mid-Michigan Section

R. James Benner, Harry L. Eiferle, Paul E. Jaquish, Irving M. Niemi, R. Paul Schreiber, Ronald C. Treloar, Clifford J. Wing, John C. Zehnder.

Milwaukee Section

John A. Gresch, Herschel A. Setser, LaVern R. Tietz, Robert C. Verhaeghe.

Montreal Section

John M. Forde, A. Ronald McKay, Glen M. Pearson, John Edward Rehder, W. G. Smith.

New England Section

George B. Coover, Edwin A. Terren.

Northern California Section

William M. Blair, William E. Bliss, Ralph H. K. Cramer, Ralph W. Henderlong, Glen V. Markham, Archer F. Neider, John W. Salter, John T. Sullivan.

Northwest Section

Donald H. Burton, Thomas G. Dennistoun, Richard K. Fergin, G. Ronald Giberson, James R. Landweer, John Reed Thayer.

Oregon Section

Norman C. Williams.

Philadelphia Section

Lawrence O. Barrett, Jr., Donald G. Civitella, Robert J. Ford, Jr., Daniel Grudin, Harlan R. Headley, Lubomyr Kociuba, Ethan A. Smith, Jr.

St. Louis Section

Charles R. Askew, Thomas A. Bauman, Robert J. Lewis, Milton J. Plomer, Richard Lee Schroeder, John A. Szabo.

San Diego Section

L. J. Bordelon, Henry W. Callihan, Ray Ditto, Glenn Karel, John Spasoff, John B. Witt.

Southern California Section

Robert W. Beavis, Frank W. Belina, Eugene Bulac, Clyde S. Burkhardt,

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CARBURETOR

Economy is a magic word in the automobile business. Economy of operation is a mighty sales clincher in any dealer's showroom. Economy in manufacture is vital to protect the narrow profit margin of the auto maker. *The Stromberg Carburetor offers you both.*

Stromberg's system of consistent fuel metering results in economy of operation unmatched by any other carburetor. Automotive experts know it. Fuel consumption statistics prove it. And two consecutive victories for Stromberg-equipped cars in the famed Mobilgas Economy Run confirm it.

But Stromberg can mean even more as an economy factor for the manufacturer. Because of the vast number of *different* carburetor models which Stromberg makes available to manufacturers, a Stromberg Carburetor can usually be selected to fit the needs of any engine with a minimum of costly revisions.

For more than forty years, Stromberg has been the American leader in every phase of carburetion. More advances in this field have been initiated by Stromberg than by any other manufacturer.

For two consecutive years, the grueling Mobilgas Economy Run has been won by a STROMBERG-equipped Studebaker.

The STROMBERG application engineer will be happy to discuss carburetion problems with you at your convenience.

The folks who make Stromberg Carburetors enjoy tackling a difficult problem—because when you have a problem we can solve, everyone is happy. You have a better product, we have a satisfied customer, and the motorist has a more efficient automobile.

Call on us. The Stromberg application engineer is at your service. You'll find he knows his business—and he may help build yours.

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precision valve gear parts

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BELLWOOD, ILLINOIS
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continued

Jimmey L. Craig, Charles R. Dauwalter, Allen R. Eberle, Horace E. Fansler, Arthur V. Fitzwater, Donald E. Geiler, Arthur Charles Haman, Robert J. Hopkins, Jr., Ray E. Huffaker, James L. Keller, Giles Arthur Kendall, Arthur J. Koski, K. V. Lamoreux, Paul L. Lemoine, John Marroquin, Jr., Patrick J. McGrath, Jr., John E. Michel, David E. Nothstine, D. L. Phillips, William T. Ray, Clyde H. Reed, Robert Gordon Reichmann, Toshiro Shiba, Julian M. Smith, Edwin V. Stephens, Harold B. Stormfeltz, Jr., Billy L. Warren.

Southern New England Section

George Anderson, Elmer G. Bull, Carl F. Christian, Russell J. Haigis, Harry C. Marugg, Adolph V. S. Mongillo, Peter T. Bercellone.

Spokane-Intermountain Section

R. E. Edens, Leo J. Peot.

Texas Section

William B. Grigsby, Henry I. McGee, Jr.

Texas Gulf Coast Section

Luther L. Harris, Louis F. King, James E. Shamblin, Douglas J. Skinner, Russell C. Sullivan.

Twin City Section

Darwin C. Hentz, Peter A. Thor, Jr.

Virginia Section

S. L. Furches, Jr., Marion G. Runge.

Washington Section

Franklin H. Baldwin, R. W. Beal, Lou Ciarrocca.

Western Michigan Section

Calvin N. DeBruin, Edward R. Goudberg, Raymond W. Lambrix, Richard E. Walton.

Wichita Section

James R. Dennison, Bernard D. Lamach.

Williamsport Group

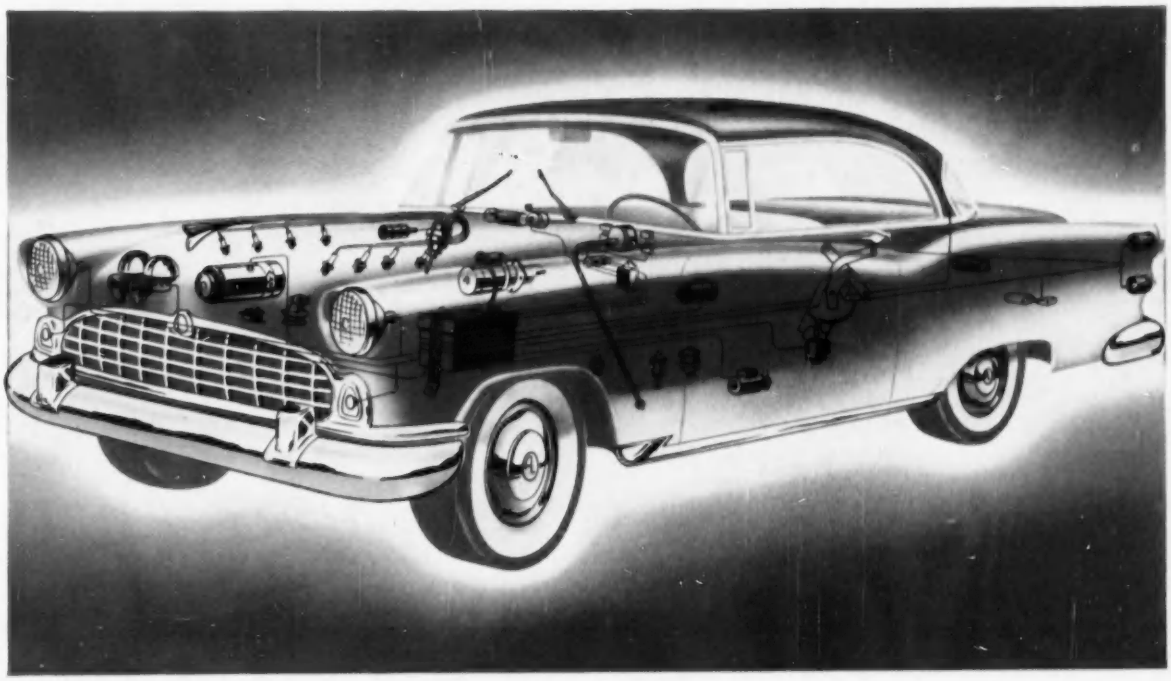
Karl A. Domeisen, George D. Lenington.

Outside of Section Territory

William J. Bowen, Wilmer J. Brice, William G. Crouch, Frank R. Dew, Kenneth W. Domier, Robert J. Dorgan, Fred C. Ewert, Herbert F. Herndon, Curtis E. Johnson, Leland Dorsey Pendleton, William J. Plunkett, Charles W. Ray, Clifford M. Rigsbee, Delmar C. Schrepple, William J. Wright.

Foreign

Vangala Bhaskara-Reddy, India; Norman Greenhalgh, India; Kondamudi Kameswara-Sarma, India; Adrien Paris, Holland; John M. Rae, England; Alex F. Schweizer, Germany.



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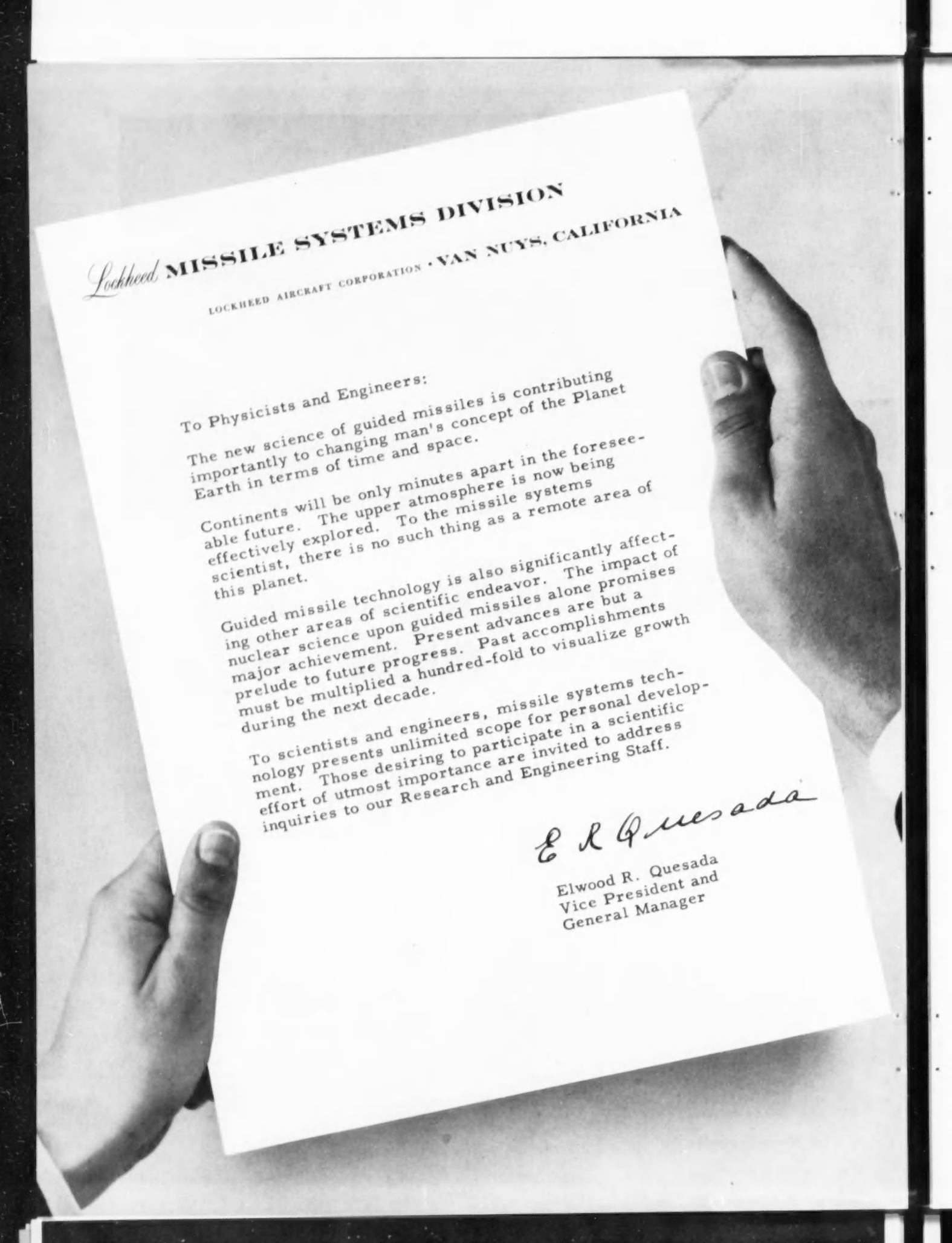

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LOCKHEED AIRCRAFT CORPORATION · VAN NUYS, CALIFORNIA

To Physicists and Engineers:

The new science of guided missiles is contributing importantly to changing man's concept of the Planet Earth in terms of time and space.

Continents will be only minutes apart in the foreseeable future. The upper atmosphere is now being effectively explored. To the missile systems scientist, there is no such thing as a remote area of this planet.

Guided missile technology is also significantly affecting other areas of scientific endeavor. The impact of nuclear science upon guided missiles alone promises major achievement. Present advances are but a prelude to future progress. Past accomplishments must be multiplied a hundred-fold to visualize growth during the next decade.

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E R Quesada

Elwood R. Quesada
Vice President and
General Manager

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1. Full-flow lube oil filters lengthen engine life

New replaceable plastic impregnated full-flow filters increase engine life by removing all harmful particles from the oil before it goes under full pressure to engine bearings. Exceptionally large filter area extends filter change period to 500 hours under normal conditions.

2. New injection pump reduces maintenance

Time proven International single and twin plunger pumps have been further simplified for longer life and lower cost maintenance. Scavenging gears and pump air pipe are eliminated . . . hardness of injection plunger increased for up to four times longer life.

3. Drilled passages assure full-time lubrication

You can be sure *all* engine bearings will be lubricated at *all* times. Lube oil is pressure-pumped through internal rifle-drilled passages that can't rupture or work loose.

4. Clean combustion on low-cost fuel

Trouble-free single orifice injection nozzles, and pre-combustion chambers mounted at 45° angle thoroughly mix fuel and air under all load and speed conditions. You get follow-through power strokes, clear exhaust, smooth idling on low-cost No. 2 fuel.

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Never mind cold—IH diesels work year 'round, even in the Arctic. Seconds-fast, they start in any weather on gasoline . . . and, seconds-fast, you switch to clean-burning, full-diesel power.

Six sizes of diesels, 52 to 190 hp, complete with radiator and fan. Also 12 models, 16½ to 200 hp, for gasoline, natural gas or LPG. See your nearest International Distributor for details.

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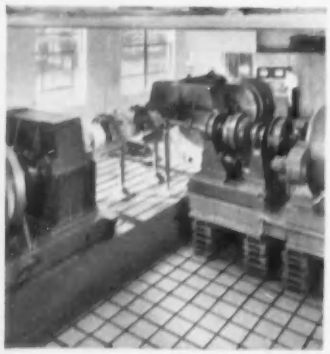


Matched to your toughest conditions

Steep grades! Heavy loads! Tough muddy going! The most adverse conditions are duplicated in our "Torture Chamber" to produce an axle tailored to *your special needs*. Stock axles are picked at random and subjected to tests the equivalent of a "chuckhole" shock every 4 seconds, 24 hours a day, for months on end. Another test simulates an uphill pull all the way from New York to California. Only tests as rugged as these could produce axles so tough.

GREATEST ADVANCE SINCE

exclusive double-reduction design 2-speed gear ratio spread!

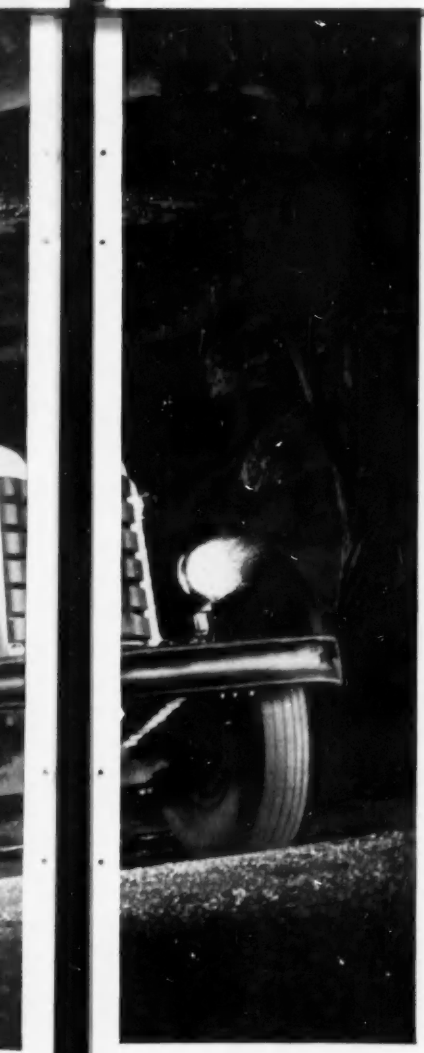
Tailor-made power exactly to your trucking needs with Timken-Detroit!

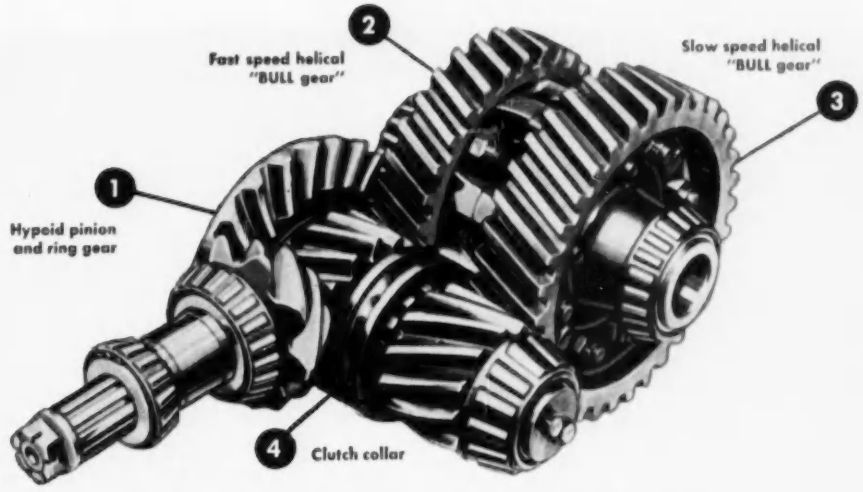
Unequalled flexibility! TDA 2-Speed Axles, give an almost *unlimited* choice of gear ratios. The Timken-Detroit design is so simple and basic, that an ordinary mechanical change lets you tailor power exactly to your trucking needs. Where other 2-speed axles limit you to only a single gear spread of 37%, TDA offers a range all the way from 28% to 49%.

TDA meets varied needs! The variety of hauling conditions that today's trucks must meet call for maximum speed and power flexibility. Other 2-speed axles are just too limited to meet this need. On the other hand, TDA's simple double reduction design gives complete flexibility. Gear ratio can be easily changed without weakening the axle unit in any way.

How you benefit! TDA not only gives you a much wider power range, but also, all the advantages of a stronger, sturdier, smoother operating design. Since helical "Bull" gear sets operate independent of one another, there is no overheating even after indefinite running in low speed. Bigger huskier TDA parts last longer, stand up better under tough usage.

Less down-time, longer axle life, fewer repairs, higher fuel economy, lower operating costs and higher profits. These are some of the important reasons why so many leading manufacturers and operators everywhere specify Timken-Detroit 2-Speed Axles.





How the exclusive double-reduction design of

TDA 2-SPEED AXLES

gives you greater speed, endurance, and economy!

This is HOW TDA's 2-Speed principle works! A husky hypoid ring gear and a bigger, stronger pinion set (No. 1 in illustration above) provide the *first step* of the total gear reduction for both fast and slow ratios. Two large, heavy-duty helical gear sets provide the *second step*. Both sets are of balanced size and capacity. One set (No. 2 in illustration) is for fast speed; the other (No. 3) is for slow speed. The clutch collar (No. 4) moves to right or left to engage one helical pinion or the other.

WHY this principle offers far wider spread! Because the TDA design is so simple, the ratio may be changed merely by changing the low speed helical gear pinion. Unlike ordinary designs which are limited to 37%, TDA offers spreads of 28%, 37%, and 49%. In effect, this flexibility gives you your choice of power ratios to exactly match your needs.

Greater endurance, longer truck life with TDA. TDA's simple design eliminates small complicated parts and midget size gears. Large hypoid helical design gives more teeth in contact – quieter operation and far less strain. Bearings are larger, too. Helical "Bull Gears" not in use idle, further reducing wear. All this adds up to longer engine life... and more efficient and profitable operation under all conditions.

THE FIRST 2-SPEED AXLE

gives TDA world's widest

TIMKEN Detroit AXLES

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ROCKWELL SPRING AND AXLE COMPANY
DETROIT 32, MICHIGAN

The Accepted TDA Standard
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World's Largest Manufacturers of Axles for Trucks, Buses and Trailers

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Increase axle life with
GENUINE TDA EQUIPMENT PARTS

Take no chances with ordinary replacement parts. For sure, dependable factory-type jobs, specify genuine Timken-Detroit axle parts kits—identical to your axles' original equipment.

Each kit is complete — gives you everything you need in one handy package. Gaskets and shim parts, brake liners, steering knuckles, differential gears — for every size of brake and axle. Order by number from your dealer. Cut labor and adjustment costs. Get trucks back on the road quicker.

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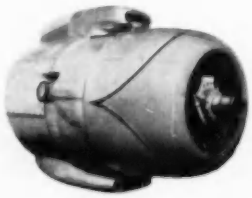
ROHR has won fame for becoming the world's largest producer of ready-to-install power packages for airplanes like the all-jet Boeing B-52, the Douglas DC-7 and other great military and commercial planes.

But the whole ROHR story is in millions of parts, for in addition to power packages ROHR builds over 30,000 other different parts for aircraft of all kinds.



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for moldable, lightweight strength!

The custom-made Metro-Lite* body places unusually high demands on the materials used. They have to be strong, light, and *easily fabricated*... and where curved components are necessary VIBRIN is used for International multi-stop trucks with these special bodies.

NAUGATUCK'S REINFORCED VIBRIN POLYESTER *IS*...

STRONGER THAN STEEL! Reinforced VIBRIN can actually be made stronger than steel by weight.

LIGHTWEIGHT! Reinforced VIBRIN is one of the lightest materials you can use... helped International attain cut-backs in weight of nearly 800 lbs.

EASILY FABRICATED! Complex, multiple curves are easily molded all in one operation.

DENT-PROOF! Reinforced VIBRIN has unusually high impact strength. And, sections that are subject to heavy road shock or impact damage can be easily strengthened by area reinforcement.

RUST-PROOF, ROT-PROOF! VIBRIN is highly resistant to abrasion, to grease, oil, and most chemicals—it is not damaged by climate or temperature extremes.

STRUCTURALLY STABLE! Reinforced VIBRIN won't warp, shrink, or lose its fit.

EASILY PIGMENTED! VIBRIN parts may be permanently colored. When painted the same color, scratches and chips do not show through.

HIGHLY FINISHED! The finish is imparted by the mold—there is no expensive make-ready prior to painting.

With all these qualifications it's no wonder more and more manufacturers are swinging to VIBRIN®. Would you like to find out how this unique plastic can put *you* on the road to more profits? Write to us on your company letterhead, TODAY!

*A modern lightweight truck body now being produced by THE METROPOLITAN BODY COMPANY, Bridgeport, Conn., subsidiary of International Harvester Co.

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Division of United States Rubber Company
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BRANCHES: Akron • Boston • Charlotte • Chicago • Los Angeles • Memphis • New York • Philadelphia • IN CANADA: Naugatuck Chemicals, Elmira, Ontario
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Plants at Detroit, Michigan and Bellefontaine, Ohio

You can rely on the same research that conceived, designed and developed the now famous and much imitated *Thin-Wall Babbitt bearing.

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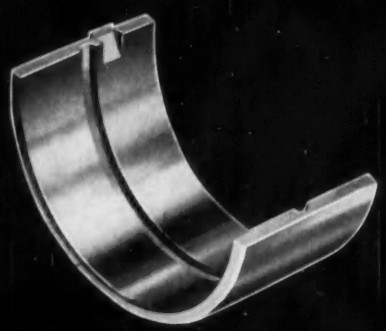
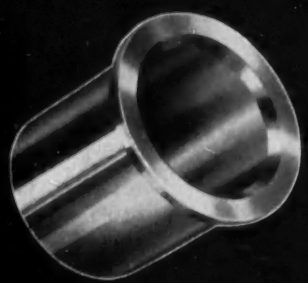
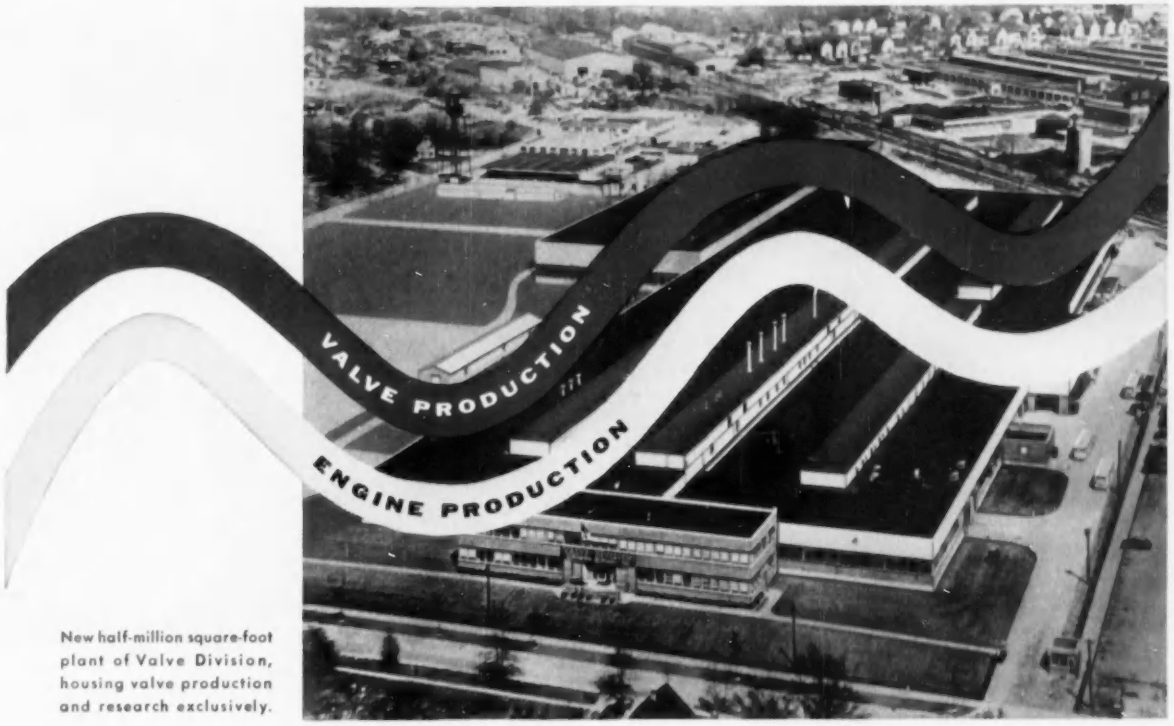




We can meet high production needs or special requirements for bearings and bushings of every type used in original equipment.

Steel backed, copper lead and aluminum alloy-lined bearings are lead-tin overplated to customer's specifications.



New half-million square-foot plant of Valve Division, housing valve production and research exclusively.

VALVE DIVISION'S NEW, LARGER PLANT relieves engine builders of valve-production problems

Bring your engine valve and other valve-train requirements to the Valve Division in its new, 500,000 square-foot plant occupied entirely by the Valve Division's manufacturing and development facilities.

Our increased capacity can easily absorb your scheduling headaches... can also provide ready-to-go facilities for engineering and research on your particular engine designs. Two problems less for automotive-, aircraft-, and stationary-engine builders.

Expanded facilities, modern production machinery and our greater flexibility assure prompt delivery of your valve-train parts to match your engine production requirements.

Let the Valve Division be the primary designer and supplier of your valve-train components . . . valves, rotators, tappets, seat inserts, locks, retainer caps, and lifters.

Valve Division

Thompson Products, Inc.

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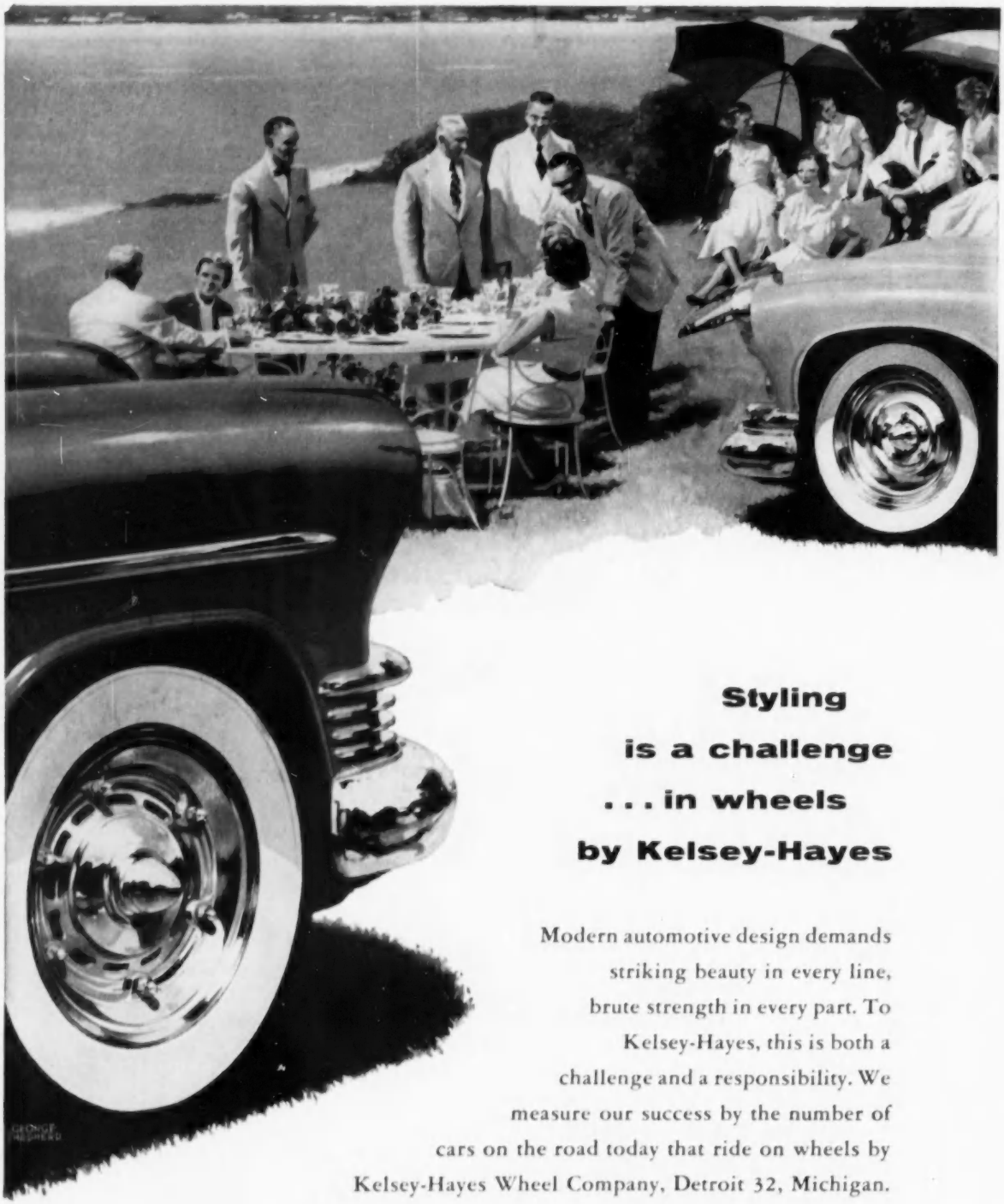


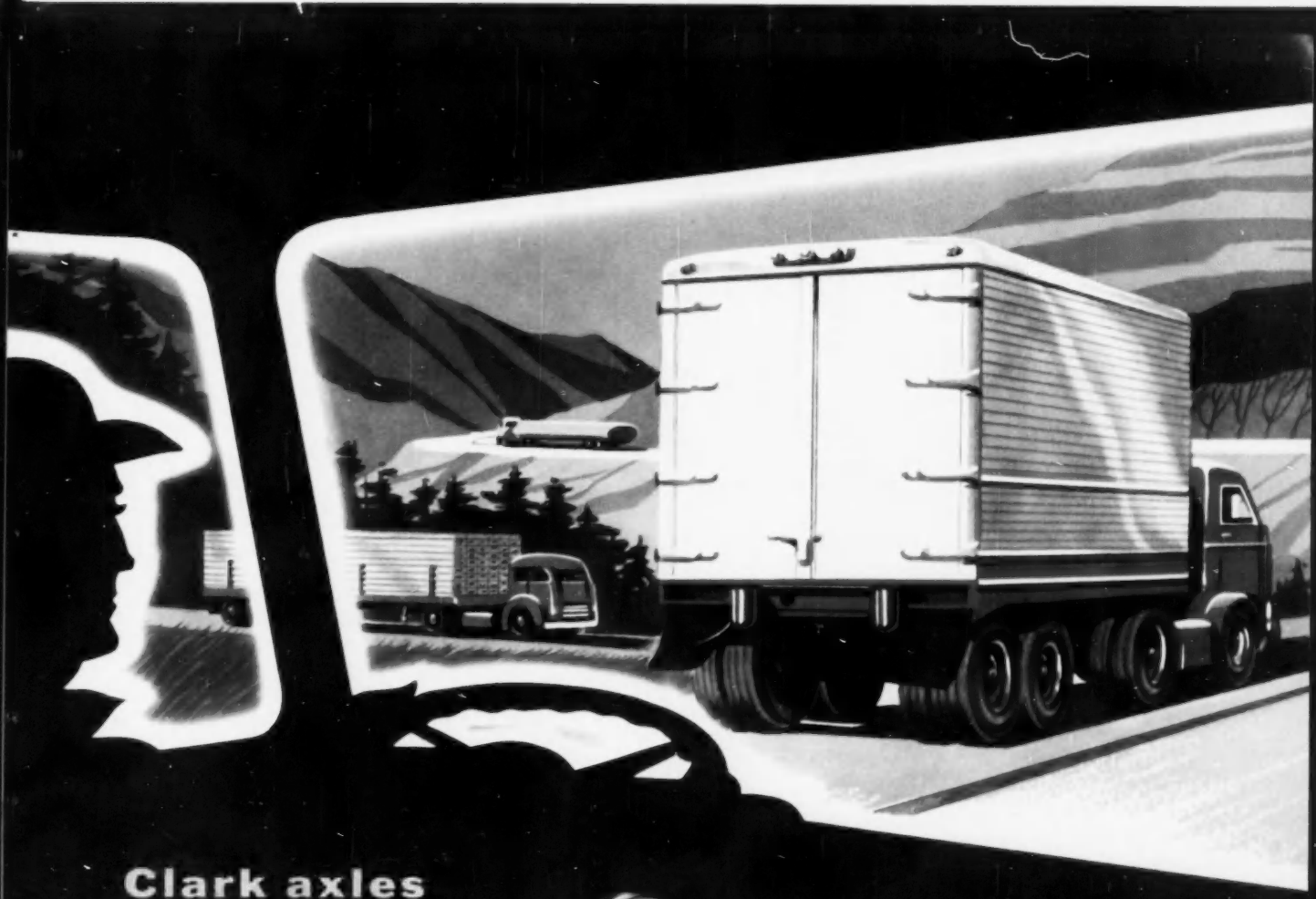
Styling is a challenge . . . in wheels by Kelsey-Hayes

Modern automotive design demands striking beauty in every line, brute strength in every part. To Kelsey-Hayes, this is both a challenge and a responsibility. We measure our success by the number of cars on the road today that ride on wheels by Kelsey-Hayes Wheel Company, Detroit 32, Michigan.

KELSEY-HAYES

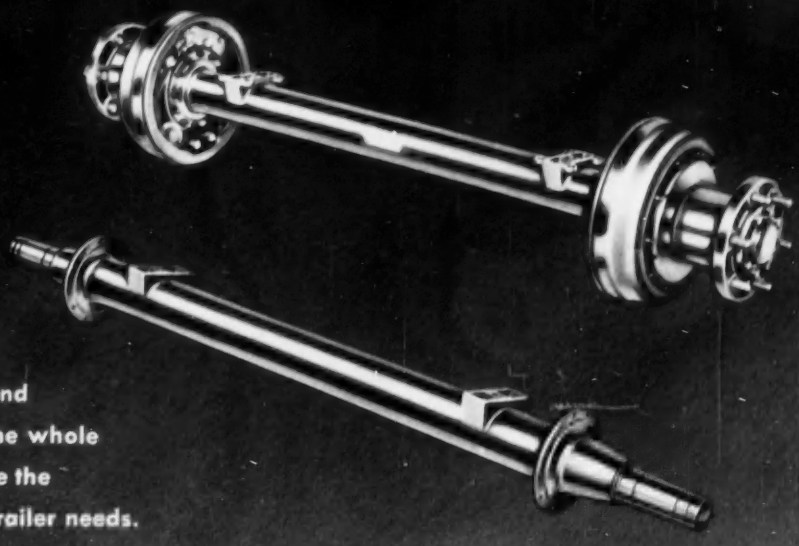
A Major Supplier to the Automotive, Aviation and Agricultural Industries

Wheels, Brakes, Brake Drums, Special Parts for all Industry
9 Plants—Detroit and Jackson, Mich. . . . McKeesport, Pa. . . . Los Angeles, Windsor, Ont., Canada . Davenport, Ia. (French & Hecht Farm Implement and Wheel Div.)



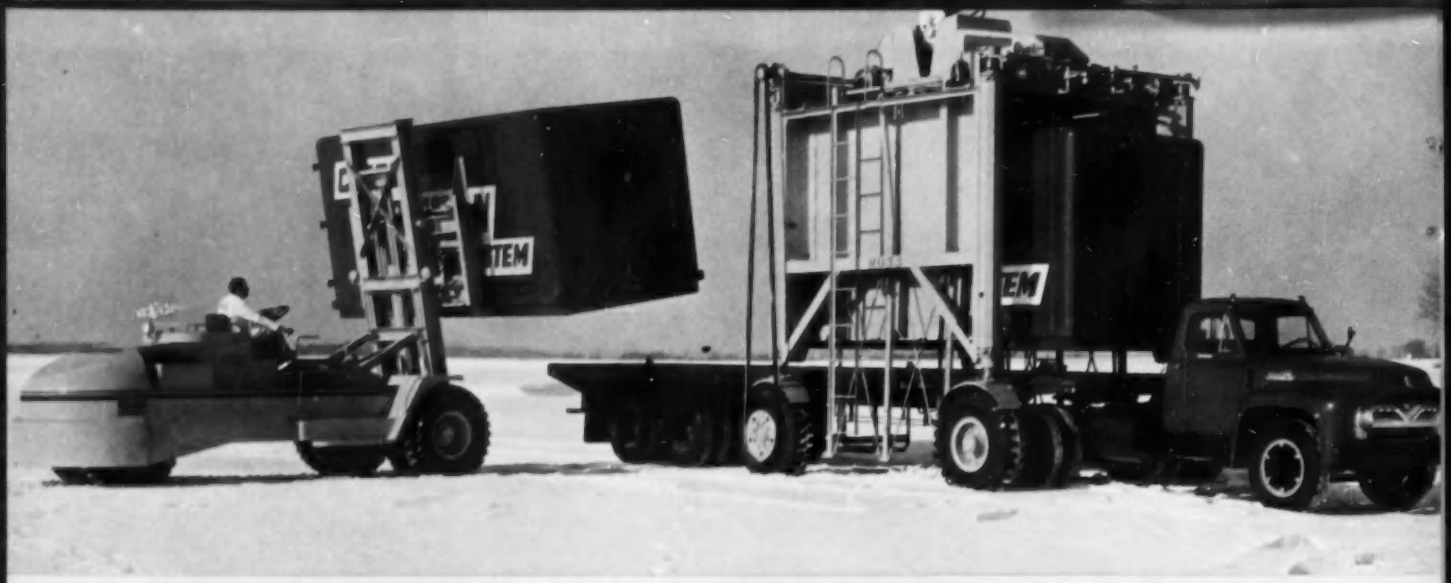
Clark axles for Trailers

Simplicity, strength and low unsprung weight—that ideal combination!—are engineered together in Clark Trailer Axles. A high carbon steel tube with integral forged spindles—spring seats and brake mountings welded on—the whole unit heat-treated: there you have the light, rigid, tough axle a good trailer needs.



CLARK EQUIPMENT COMPANY • JACKSON • Buchanan, Battle Creek and Benton Harbor, Michigan

CLARK® EQUIPMENT



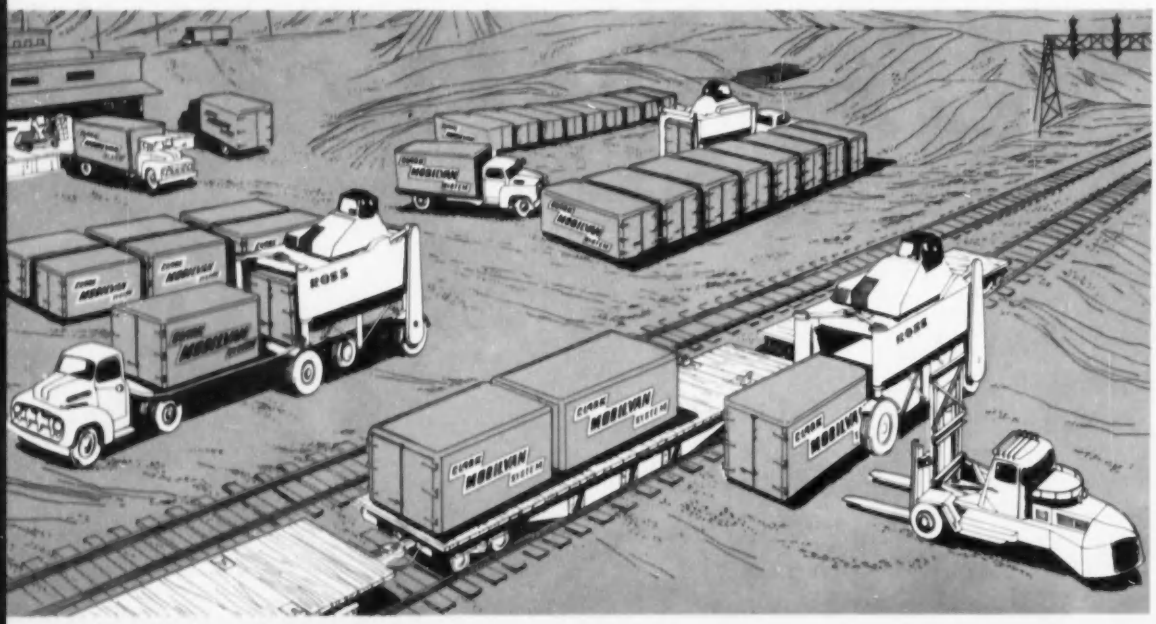
Load 40,000 lbs. of material in seconds with CLARK'S MOBILVAN SYSTEM!

In the search for faster, more efficient ways to move material, Clark Equipment Company has developed the Mobilvan System—designed to speed freight movement by truck or rail or combination of both.

The 20,000-lb. capacity vans are actually sturdy mobile-warehouses; cargo is loaded into them conventionally. Then, as shown in the photograph, a 30,000-lb. Clark lift truck or straddle-type carrier lifts them intact aboard a flatbed trailer. A unique locking device automatically secures the "Mobilvans" to the bed of the trailer. The same basic procedure applies to shipments by rail flatcar.

Lift truck or straddle-type carrier can be used interchangeably, depending on terminal conditions. An experienced operator of either can load a "Mobilvan" onto a trailer or flatcar in approximately 25 seconds. Standard flatcars or trailers require only the simple, inexpensive installation of the automatic locking device for Mobilvan service.

The "unit load" principle of the Mobilvan System cuts handling time. The one-man operation of lift truck or carrier cuts overhead. And since "Mobilvans" can be set aside until their contents are needed, the system frees expensive rolling equipment and valuable warehouse space for more productive use.



Write for 6-page folder containing details and schematic drawings of the Mobilvan operation.

CLARK EQUIPMENT

Industrial Truck Division
CLARK EQUIPMENT COMPANY
Battle Creek, Michigan

How Holley's rolling laboratories test the fuel metering devices for tomorrow's cars and trucks

When a carburetor prototype or an important design change has proven its merit at Holley's "inside" research lab, it's sent to the world's toughest proving ground—the streets and highways of America.

Holley's inside research and development laboratory—one of the best equipped in the automotive industry—can tell only part of the story. Cold room, dynamometer, and air box testing simulate to a high degree the driving conditions a carburetor prototype will ultimately face. Even before these physical tests, an electronic computer—Holley acquired one of the first in the automotive industry—checks and tabulates design theory from drawing board specifications.

But ultimately, the most conclusive test is found on city streets, country roads and super highways. Holley engineers frequently average 500 miles a day for ten days measuring a carburetor's performance in heavy traffic or on super highways.

The results of this concentration on research both "inside" and "outside" have helped to bring Holley equipped cars 5 sweepstakes champions in Mobilgas Economy Runs and 3 straight Heavy Stock Car winners in the fabulous Pan American Road Race.

HOLLEY Carburetor Co.

FOR MORE THAN HALF A CENTURY —ORIGINAL EQUIPMENT MANUFACTURERS FOR THE AUTOMOTIVE INDUSTRY.

11955 E. NINE MILE ROAD, VAN DYKE, MICHIGAN

1-23

Here's why the IPC "Bond" stays . . . stuck

It's more than a sticking process! IPC in laboratory preparation has discovered a special bonding agent which, under proper molding, causes an affinity between rubber and metal.

IPC bonded case seals and bonded washers can be submitted to the most grueling strain. *The bond between metal and rubber will not break down.*

This absolute adhesion is your protection against packing failure. Your problem can be solved by IPC's "custom bond." Write for details, today.

INTERNATIONAL PACKINGS CORPORATION

Bristol, New Hampshire

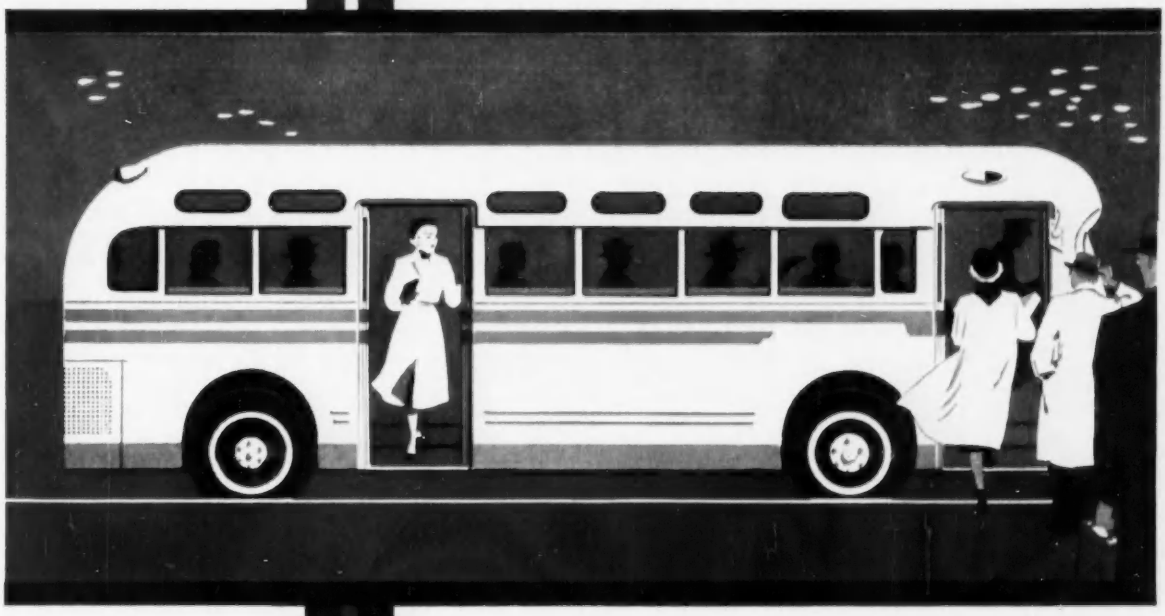
Branch Offices: Chicago, Dallas, Detroit, Kansas City, New York, Philadelphia, San Francisco, St. Louis.

BONDED BY IPC

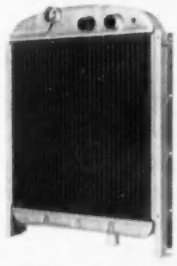
1. Bonded Washer Seal Double Lip Wiper
2. Bonded Case Seal Double Lip Wiper
3. Bonded Washer Seal Straight Lip
4. Bonded Washer Seal Limited Contact Lip
5. Bonded Washer Seal Straight Lip With Garter Spring
6. Bonded Washer Seal Limited Contact Lip With Garter Spring
7. Bonded Case Seal Straight Lip
8. Bonded Case Seal Limited Contact Lip
9. Bonded Case Seal Straight Lip With Garter Spring
10. Bonded Case Seal Limited Contact Lip With Garter Spring
11. Bonded Case Seal Straight Lip Thin Rind Type
12. Bonded Case Seal Limited Contact Lip Thin Rind Type
13. Rubber Covered Bonded Case Seal Straight Lip
14. Rubber Covered Bonded Case Seal Limited Contact Lip
15. Rubber Covered Bonded Case Seal Straight Lip With Garter Spring
16. Rubber Covered Bonded Case Seal Limited Contact Lip With Garter Spring

P6

COOL RUNNING COACH



Harrison's holding the heat line for the bus lines!



Heat never holds this bus up! Its engine is cooled efficiently, dependably, economically by a Harrison radiator. And buses must be *cooled right to meet tight schedules*—to carry heavy payloads in stop-and-go traffic, day after day and year after year!

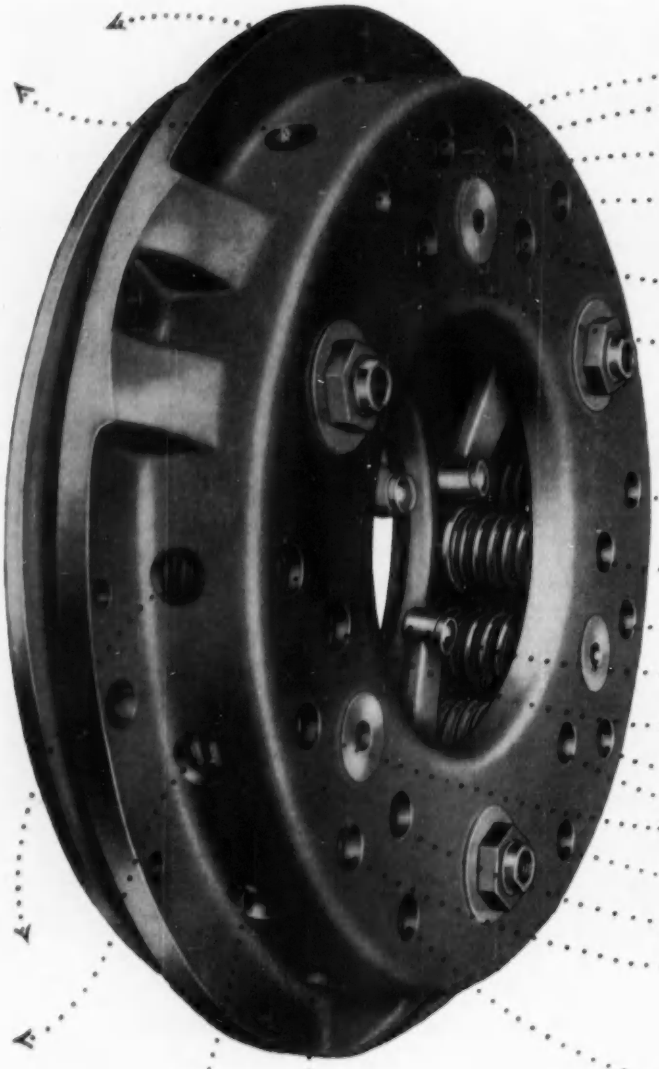
This is but one example of the heavy-duty cooling job Harrison is doing everywhere—in trucks and tractors . . . trains and planes . . . on *nearly half the new cars on the road!* In fact, wherever cooling is called for, there's a good chance you'll find a Harrison heat exchanger on the job. If *you* have a cooling problem—follow the lead of so many manufacturers—*go to Harrison for the answer!*

GM GENERAL MOTORS

TEMPERATURES MADE TO ORDER

HARRISON

RADIATOR DIVISION, GENERAL MOTORS CORP., LOCKPORT, N.Y.



air-conditioned cover keeps new clutch c-o-o-l

Frictional heat has little effect on the new *Lipe* Direct Pressure Clutch. Air circulating through the cover's 33 ventilating holes dissipates heat rapidly. The result is a heavy-duty clutch singularly free of burned facings and warped pressure plates. A clutch whose low maintenance cost matches its low first cost.

Lipe Direct Pressure Clutches now available: 13", 14", 15" single-plate, 14" and 15" two-plate. Send for complete information.

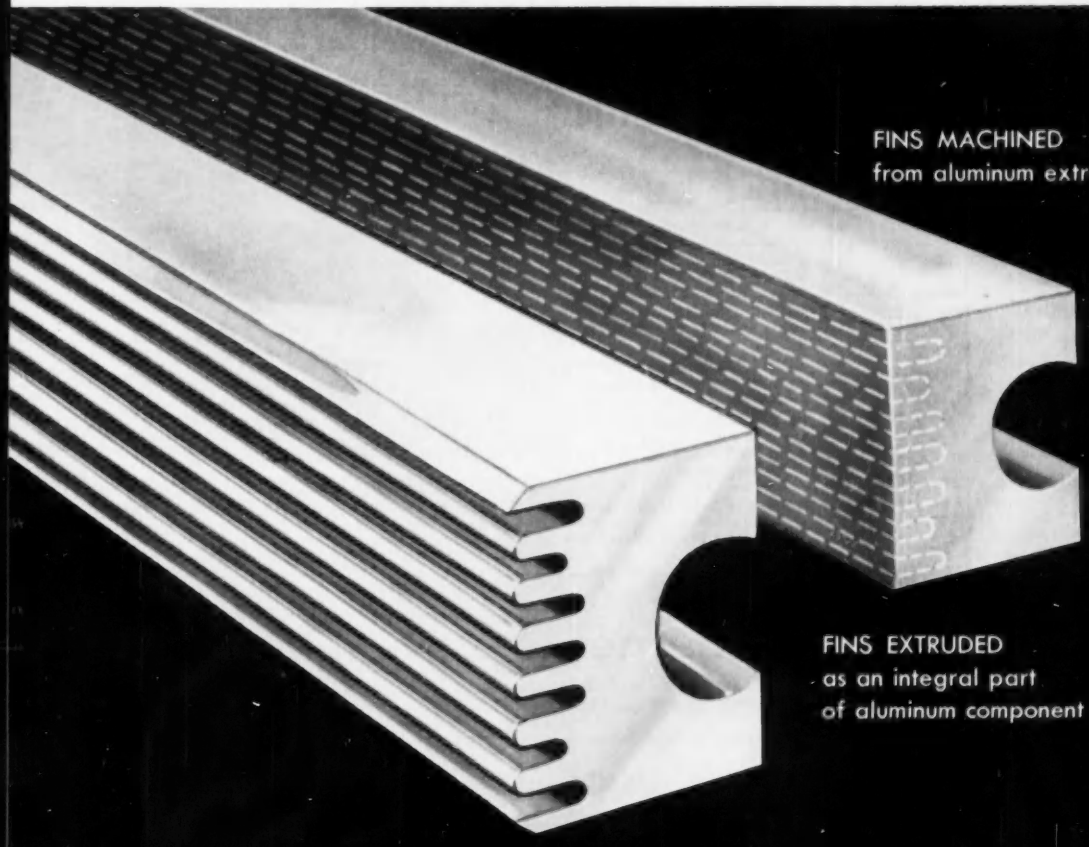
For the name of your nearest Authorized Lipe Distributor, look under "Clutches" in your telephone directory. Or, write us.

Manufacturers of Automotive Clutches & Machine Tools

LIPE ROLLWAY

Lipe-ROLLWAY CORPORATION SYRACUSE 1, N. Y.

The Case of the Extravagant Extrusion



PROBLEM:

A manufacturer whose product normally operated under intense reflected heat conditions was forced to machine fins into an extruded aluminum component in order to dissipate the heat at a satisfactory rate. Cost of the machining, however, was almost prohibitive.

SOLUTION:

Bohn engineers were consulted. After a series of production experiments, they devised a method of extruding the fins as an integral part of the component.

RESULT:

(1) The entire machining operation was eliminated.
(2) The cost of the extrusion itself was reduced because less aluminum was required.

BOHN

ALUMINUM & BRASS CORPORATION

1400 LAFAYETTE BLDG.
DETROIT 26, MICHIGAN

EXTRUSIONS • CASTINGS • FORGINGS • PISTONS • BEARINGS • BRASS ROD • BRASS AND BRONZE INGOTS • REFRIGERATION AND AIR CONDITIONING PRODUCTS

Sales Offices: Boston, Chicago, Cleveland, Dayton, Detroit, Indianapolis, Los Angeles, Milwaukee, Minneapolis, Moline, New York, Philadelphia, Rochester, St. Louis

DU MONT'S completely new line of Laboratory Instruments...

In only a year, Du Mont has *revolutionized* its entire line of cathode-ray equipment, introducing nine brand new oscillographs which set new standards for precision, reliability and convenience across the entire range of laboratory applications. Among the instruments listed is one tailor-made for your job.

9 new oscillographs

Type 323	Medium-voltage, wide-band (dc to 10 mc) high-precision quantitative oscillograph. $995.00.
Type 324*	Very-high-sensitivity (1.33 millivolts/inch) high-stability in low-frequency range. $695.00.
Type 327	Modest cost, high linear; precision measurements from dc to medium-high-frequencies. $695.00.
Type 329	High-precision, high accelerating potential for the ultimate in high-frequency measurements (dc to 10 mc). $1090.00.
Type 331	Miniaturized, wide-band, quantitative oscillograph offering superlative performance from dc to 4 mc. Price on request.
Type 333*	High-sensitivity (1.33 millivolts/inch) high-precision dual beam oscillograph. $990.00.
Type 340*	General-purpose, low-frequency instrument; identical X and Y amplifiers; with negligible phase shift. $335.00.
Type 341*	Identical X and Y amplifiers with negligible phase shift from dc to 1 mc. $415.00.
Type 336	Superior instrument for high-precision measurement of signals from dc to beyond 18 mc. $1125.00.

These new oscillograph record cameras provide unprecedented versatility and convenience for every type of cathode-ray recording.

4 new cameras

Type 298	The ultimate for high-speed single-frame recording, f/1.5 lens. $465.00.
Type 299	Interchangeable backs for versatile, general-purpose, single-frame recording, f/1.9 lens. $335.00.
Type 302	Polaroid back for finished print in one minute; back interchangeable with Type 299; f/1.9 lens. $355.00.
Type 321-A	Continuous-motion or single-frame recording over complete range of laboratory applications, f/1.5 lens. $1050.00.

NEW QUICK REFERENCE CATALOG

Second edition—brought up to date to include all the latest additions to the new Du Mont line—is just off the press. Get your copy by writing to the address below.

7 new accessories

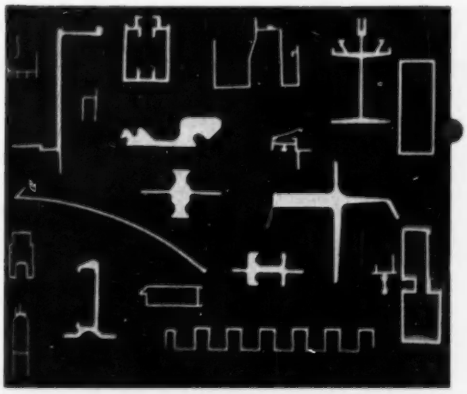
Type 300	Crystal-controlled time calibration pulses for use as accurate and dependable time-marker standard. $225.00.
Type 325	TV line selector for converting any cathode-ray oscillograph into a video signal monitor. $235.00.
Type 326	Time-delay generator for high-precision measurements of time with **any** oscillograph, 0-10,000 usec range. $375.00.
Type 330	Electronic switch converts any single-channel cathode-ray oscillograph to dual-channel, or any a-c coupled oscillograph to d-c operation, dc to 15 mc. $225.00.
Type 332	Differential transformer control is complete unit for differential transformer operation. $245.00.
Type 335	Strain-gage control for use with any commercial strain-gage. $195.00.
Type 2611	Line control unit provides regulated power from 0 to 135 volts. $75.00.

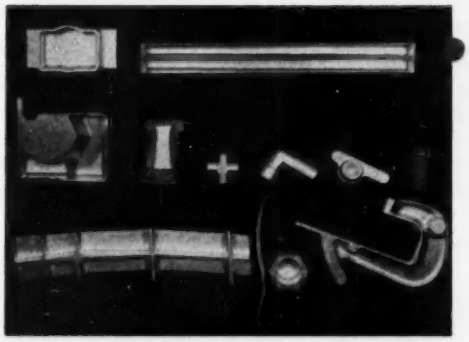
**Rack-mountable versions available.*

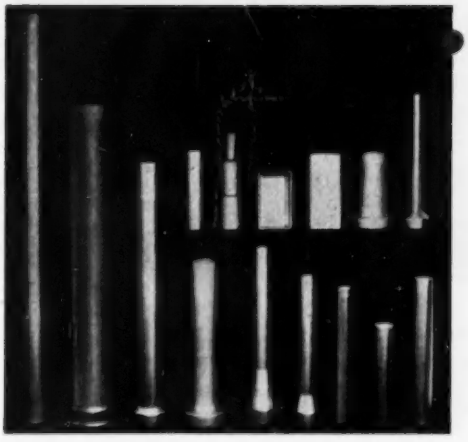
DU MONT

Technical Sales Department
ALLEN B. DU MONT LABORATORIES INC.
760 Bloomfield Ave., Clifton, N. J.

You can make it faster and better with HARVEY ALUMINUM







Here are a few of the many ways Harvey Aluminum makes your product easier to manufacture, easier to sell . . . saves you time, material, and manpower . . .

EXTRUSIONS . . . For decorative as well as basic parts, custom-designed aluminum extrusions replace riveted and welded assemblies . . . simultaneously increase strength and simplify fabrication.

STRUCTURALS . . . High strength, light weight, workability, corrosion resistance. Aluminum extrusions combine all four . . . are ideal as basic load-bearing members.

MACHINING STOCK . . . Harvey deep-drawn hex and round stock set a new mark in uniform grain structure—consistent from surface to core. This means fast, chatter-free cutting, long tool life, few rejects and true threads.

PRESS FORGINGS . . . Where parts must combine maximum strength with savings in weight, cost and manpower, Harvey aluminum forgings often completely solve a designer's problem.

FORGING STOCK . . . If you make your own forgings in quantity, Harvey extruded forging stock can save many intermediate steps. Custom-designed extrusions whose cross sections approximate the forged blanks may be cut to length.

EXTRUDED PIPE AND TUBE . . . Seamless . . . uniform in structure, size and shape . . . clean and smooth inside and out . . . easily formed. Usable in applications ranging from portable irrigation systems to aircraft heat exchangers.

IMPACT EXTRUSIONS . . . Thin-walled, tubular structures can be produced by this method and held to very close tolerances. Machining is practically eliminated, and scrap is greatly reduced.

DRAWN TUBE . . . Combines strength and high finish . . . ideal for TV antennas, furniture, and similar products. Cold drawn for structural uniformity . . . temper specially controlled for workability.

AUTOMATIC SCREW MACHINE PRODUCTS . . . The West's largest installation of multiple-spindle screw machines can reduce your manufacturing costs. Harvey carries your job through every step —from engineering through quality control.

Harvey is a leading independent producer of aluminum extrusions in all alloys and all sizes, special extrusions, press forgings, hollow sections, structurals, rod and bar, forging stock, pipe, tube, impact extrusions, aluminum screw machine products and related products. Also similar products in alloy steel and titanium on application.

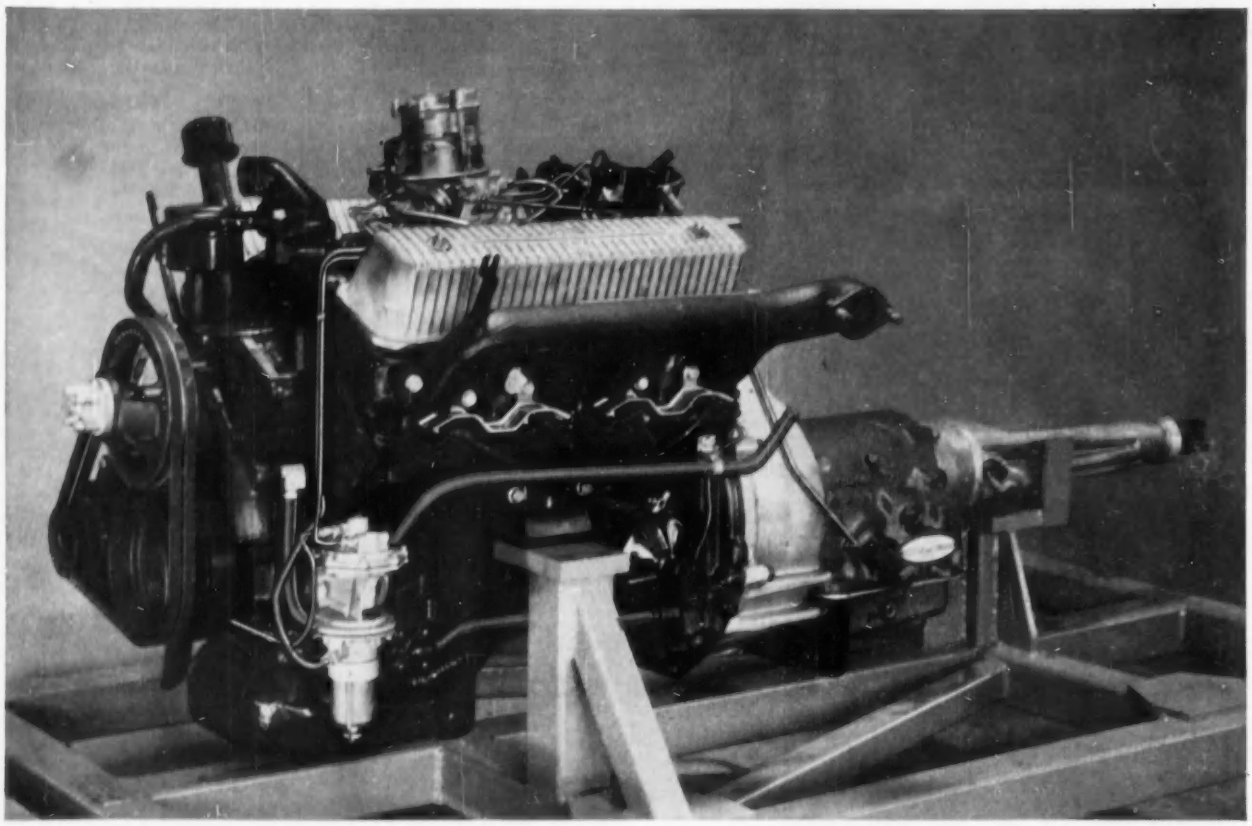
MAKING THE MOST OF ALUMINUM . . . FOR EVERYONE

HARVEY Aluminum

HARVEY ALUMINUM SALES, INC., TORRANCE, CALIFORNIA—BRANCH OFFICES IN PRINCIPAL CITIES

Bundyweld Tubing is of distinguished,

Mechanical appointments in luxurious Continental feature 30 parts made of Bundyweld Tubing—a total of 87½ feet of tubing in each car



This smooth, quietly operating engine uses Bundyweld Tubing for vital gas, oil, gauge, and lubrication lines. Bundyweld gives dependable, precision performance necessary in distinctive automobiles, such as the Continental. It is a sturdy, leakproof tubing that withstands heavy vibration fatigue and punishing wear, has a high fatigue limit. It is produced in sizes up to ⅝" O.D.

WHY BUNDYWELD IS BETTER TUBING

Bundyweld starts as a single strip of copper-coated steel. Then it's . . .

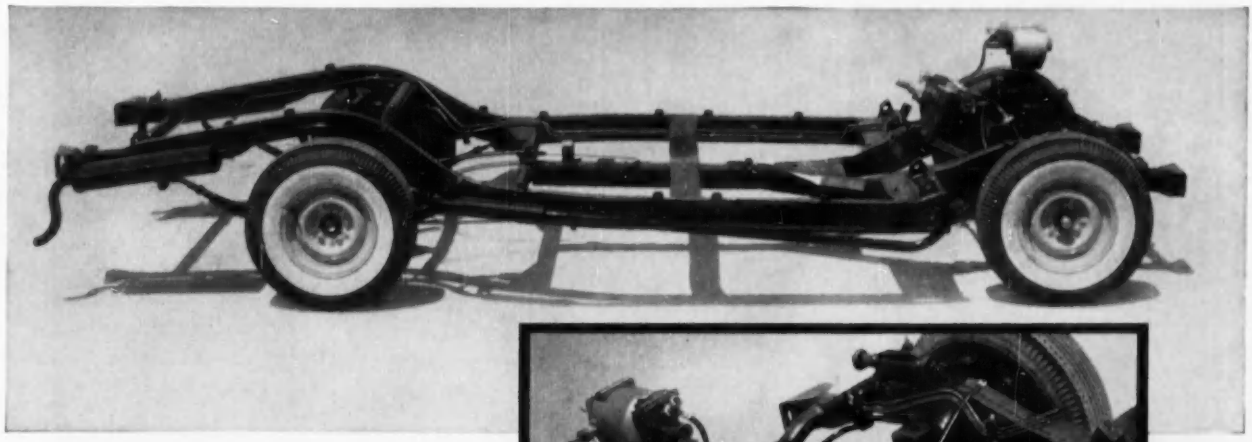
continuously rolled twice around laterally into a tube of uniform thickness, and

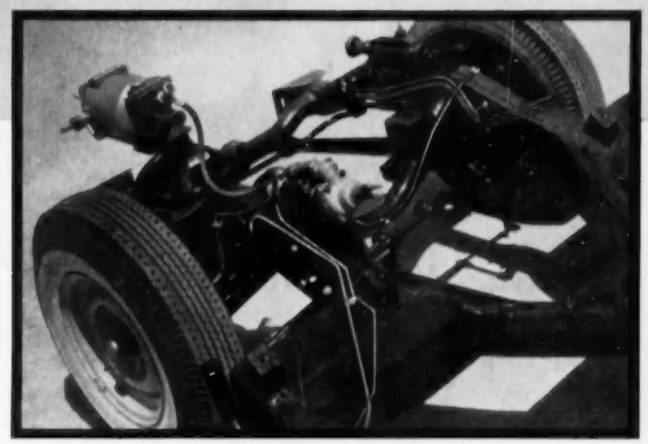
passed through a furnace. Copper coating fuses with steel. Result . . .

Bundyweld, double-walled and brazed through 360° of wall contact.

NOTE the exclusive Bundy-developed beveled edges, which afford a smoother joint, absence of bead, and less chance for any leakage.

used for the "lifelines" new Continental





Bundyweld is also used in the distinguished Continental for brake, heating, air-conditioning, and control lines. This quality tubing is thinner walled, yet stronger; has high bursting strength; takes easily to standard protective coatings. (Illustrations show Bundyweld in copper – its "from the mill" color. Actually, on the Continental, it is solder-coated, with exposed parts painted as it is assembled.)

Whatever the automotive application for Bundyweld Tubing – ranging from powerful and distinguished cars like the Continental, to rugged automotive giants of farm and industry – you can be sure of dependable performance with Bundyweld STEEL Tubing. Only STEEL tubing is strong enough to take punishing wear, and give added safety in mechanical operations.

Bundyweld Tubing is used by leading automotive manufacturers like the Continental Division, Ford Motor Company, for hydraulic lines to assure safe stops. It is preferred, too, for oil lines, to save costly repairs; for gasoline lines, to assure leakproof performance; for push rods, to produce more powerful overhead-valve engines. In fact, Bundyweld *is used in 95% of today's cars, in an average of 20 applications each!*

There are expert technicians at Bundy available to help you with your tubing problems. We have advanced facilities for fabrication, and offer prompt, on-schedule delivery. Why not get in touch with us today?

BUNDY TUBING COMPANY
DETROIT 14, MICHIGAN

BUNDYWELD TUBING®

DOUBLE-WALLED FROM A SINGLE STRIP

Bundy Tubing Distributors and Representatives: ***Cambridge 42, Mass.:*** Austin-Hastings Co., Inc., 226 Binney St. • ***Chattanooga 2, Tenn.:*** Peirson-Deakins Co., 823-824 Chattanooga Bank Bldg. • ***Chicago 32, Ill.:*** Lapham-Hickey Co., 3333 W. 47th Place • ***Elizabeth, New Jersey:*** A. B. Murray Co., Inc., Post Office Box 476 • ***Los Angeles 58, Calif.:*** Tubesales, 5400 Alcoa Ave. • ***Philadelphia 3, Penn.:*** Rutan & Co., 1717 Sansom St. • ***San Francisco 10, Calif.:*** Pacific Metals Co., Ltd., 3100 19th St. • ***Seattle 4, Wash.:*** Eagle Metals Co., 4755 First Ave., South ***Toronto 5, Ontario, Canada:*** Alloy Metal Sales, Ltd., 181 Fleet St., E. • **Bundyweld nickel and Monel tubing are sold by distributors of nickel and nickel alloys in principal cities.**

On the assembly line of the auto industry's newest V-8 engine, specially designed Johnson main bearings fit perfectly into position with a touch of the fingers.

Read Why The Makers Of This New V-8 Chose Johnson As A Supplier Of Bearings

Months before the introduction of this new engine, Johnson engineers were called in to consult with automotive engineers in the customer's plant on specifications for bearings in crankshafts, connecting rods and camshafts.

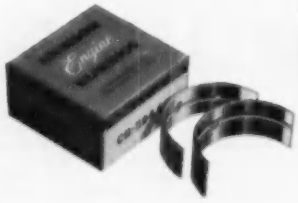
All connecting rod and main bearings were specified as *super micro-babbitt* with *steel backs*. *Lead base babbitt* was selected except in the flanged No. 3 main bearing which takes the thrust. This bearing was to be *tin base babbitt* which gives excellent resistance to wear under thrust loading.

Trial lots of bearings were subjected to exhaustive testing in the research lab and on the proving grounds.

Result? Johnson met the specifications perfectly and was awarded a large share of this customer's bearing needs. Receiving and inspection men, supervisors, and workmen welcome the arrival of Johnson Bearings on the assembly line because it means uninterrupted production—less headaches for all concerned.

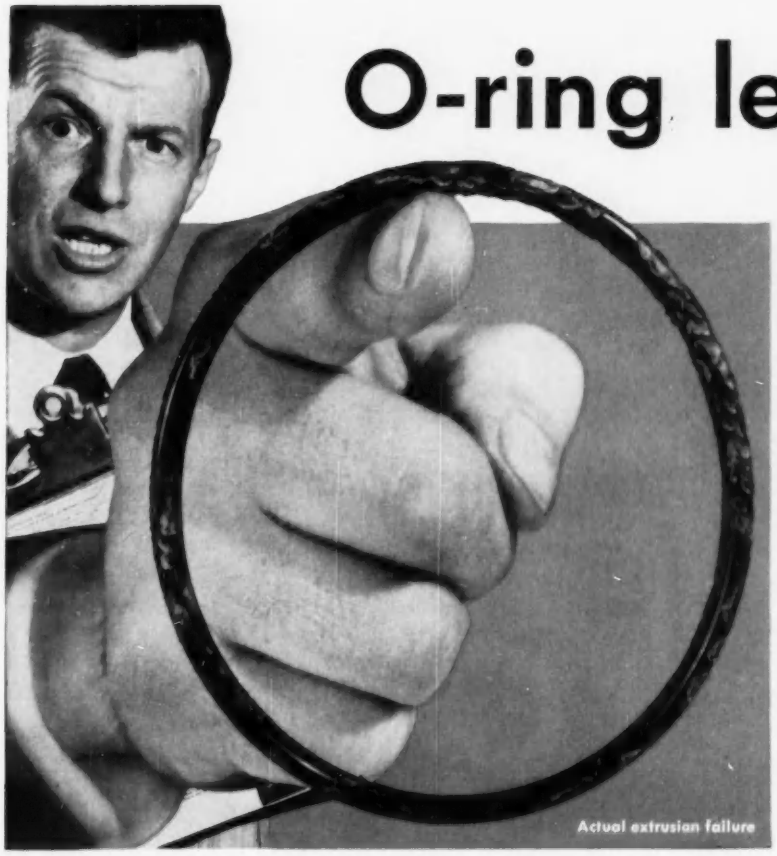
Johnson supplies original equipment engine bearings to the leading automotive companies because Johnson can be depended upon to deliver the exacting tolerance, mirror like finishes, and carefully compounded chemical analysis of the metals required, bearing after bearing, order after order, at competitive prices.

If you have a hand in the production of engines—automotive, marine and industrial, either gasoline or diesel—and you have a problem in the design, construction or operation of bearings, a Johnson engineer will welcome the opportunity to talk it over without cost or obligation. Call, write or phone sleeve bearing headquarters, the Johnson Bronze Co., 675 S. Mill St., New Castle, Pa.



Johnson Bearings

O-ring leaks?



. . . then call in your Parker field engineer for help

Having trouble with O-ring failures? Nibbled, worn, battered, leaking like a sieve? Whether your problem is in the basic design or compound, it's time to call a Parker representative.

Parker field engineers are trained trouble shooters. There is one in your area. From Parker you can get exactly the *right* O-ring and gland design for your *specific* application.

Compare Parker O-rings with any other make. You'll find that Parker O-rings are precision-molded of superior compounds. They have been developed as the result of years of experimentation to provide the proper elongation, tensile strength, compression set ratings, resistance to oils, fuels, chemicals, and high and low temperatures. Laboratory and service tests make sure that all rated characteristics are held.

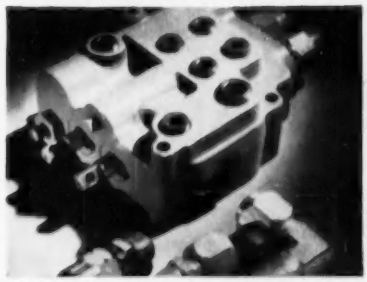
Call your Parker representative for assistance. Mail the coupon for *free* technical bulletins about O-rings.

RUBBER PRODUCTS DIVISION
The Parker Appliance Company
17325 Euclid Ave., Cleveland 12, Ohio
1538 So. Eastern Ave., Los Angeles, Cal.

Parker
Hydraulic and fluid system components

Heat failure was caused by a combination of compound and design problems. Parker field engineer was called. Leaks were stopped . . . and complaints ended.

Compare actual samples. Ask your Parker representative to check your specifications and design. Let him prove how Parker O-rings seal better, last longer.



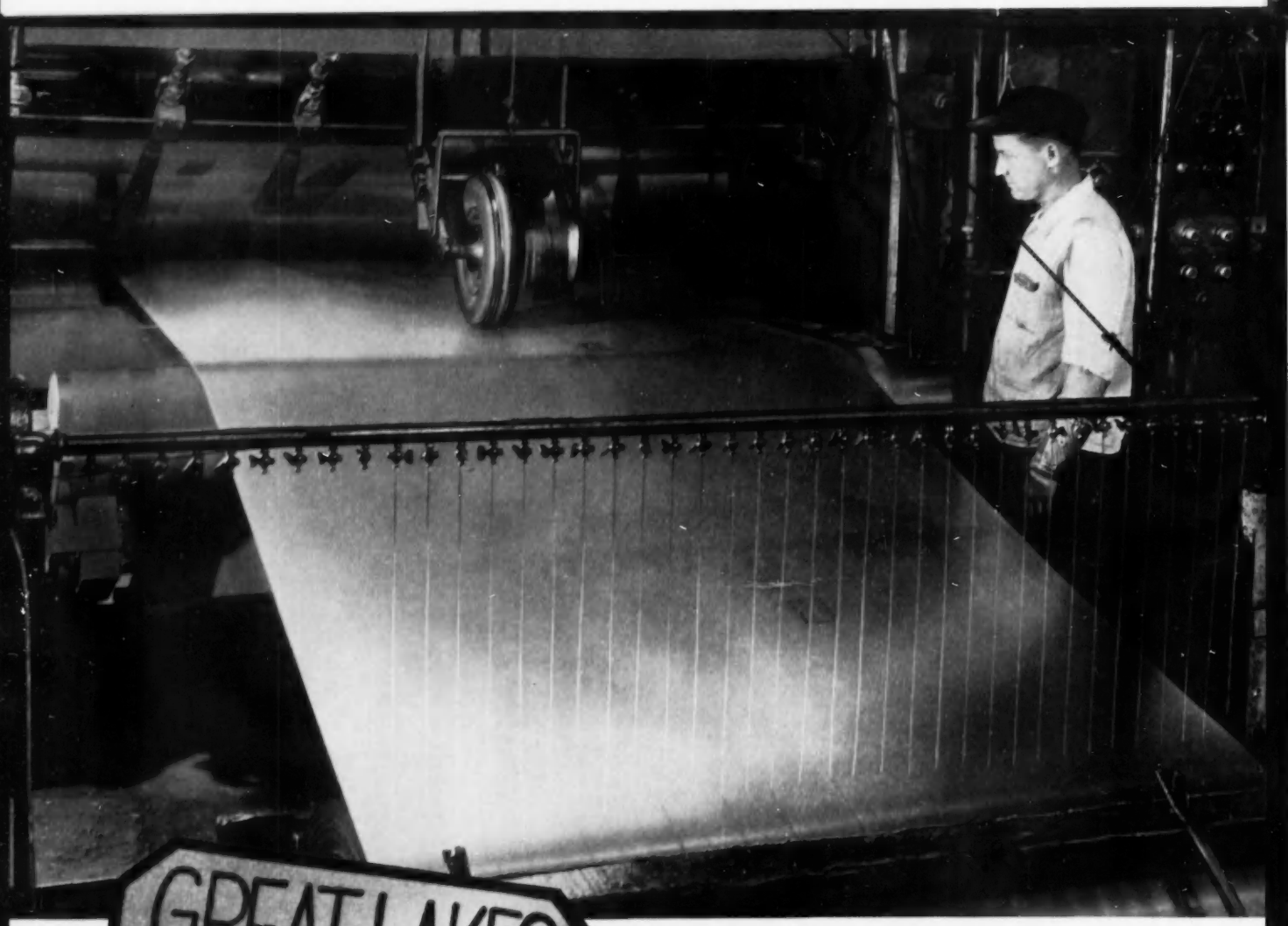
What other Parker products interest you? *Triple-lok* flare tube fittings? Ferulok flareless fittings? *Hoze-lok* fittings? Hydraulic directional control valves?

RUBBER PRODUCTS DIV.
Section 513-M
The Parker Appliance Co.
17325 Euclid Ave.
Cleveland 12, Ohio

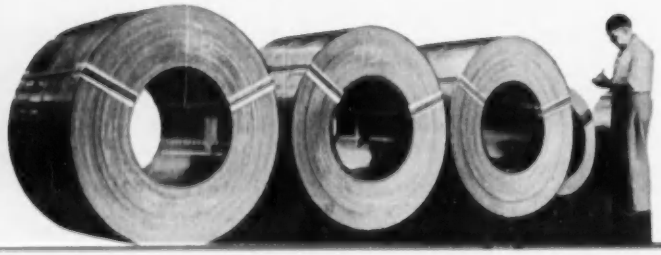
Please send the following bulletins:

- ☐ Silicone Rubber Bul. 5605 B1
- ☐ Materials for O-rings Bul. 5705 B1
- ☐ O-ring Operation Factors Bul. 5705 B2
- ☐ Thermal Properties Bul. 5705 B4
- ☐ Rotary Seal for High Speed Bul. 5705 B3
- ☐ Aircraft Hydraulic Packings Bul. 5712 B1

Name _____
Company _____
Address _____
City _____ State _____



Devices such as the one shown in operation above stamp our steel with our name. Each lift and coil Great Lakes Steel produces carries such a stamp or tag bearing an identification number from which the complete history of the material concerned can be obtained.



How Great Lakes Steel *identifies* quality

Because this identification helps us give better service to our customers, it is an important aid toward an all-important goal. The goal can be summed up: *Give each customer the quality of steel to meet his requirements—when and as wanted.*

Men throughout the mill insist on *quality with service* for our customers.

We invite you to talk over your production problems with a Great Lakes representative. His assignment is to bring into your plant the steelmaking knowledge and experience of the Great Lakes organization.

GREAT LAKES STEEL CORPORATION

Ecorse, Detroit 29, Michigan • A Unit of

NATIONAL STEEL CORPORATION

Aero Commander • AT-7 • AT-10 • AT-11 • C-43 • C-45 • Bonanza • Twin Bonanza • T-34
Air Cobra • King Cobra • H-13 (Helicopter) • Flying Fortress • Super Fortress • C-97
Cessna 140 • Cessna 170 • Cessna 180 • Cessna 190 • Cessna 195 • Cessna 305
Cessna 310 • B-24 • B-32 • B-36 • C-81 • C-87 • L-5 • Catalina • PB2Y • T-29A
Convair 240 • Convair 340 • Helldiver • Seahawk • P-40 • P-42 • P-60
P-62 • A-20 • A-24 • A-26 • B-19 • B-23 • C-32 • DC-3 • C-48 • DC-4
C-67 • DC-6 • DC-6B • DC-7 • DC-2 • Globemaster II • Super DC-3
AD Series • Skyraider • Gunner • Forwarder • C-82 • C-119 • XC-120
ZPN (Blimp) • AF2W • ZP2K (Blimp) • ZP5K (Blimp) • F4F • TBF-6
TB3F • Lodestar • H-23 (Helicopter) • A-28 • A-29 • AT-18 • B-34
B-37 • B-38 • C-36 • C-37 • C-63 • Constellation "049"

what do these famous aircraft have in common?

Constellation "749" • Super Constellation "1049"
PV-1 • PV-2 • P2V Series • XR-60-1 • B-26
Mars • P4M-1 • P5M • PBM • Martin 202
Martin 404 • AJ-1 • B-25 • P-51 • T-28
C-125 • P-61 • Apache • XF-12
Rainbow • P-47 • Seabee • Fireball
HSL (Helicopter) • Navion • PT-22
Courier (Helicopter) • Learstar • Super
Constellation "1049 G" • HUP-4
(Helicopter) • PT-25 • H-21
(Helicopter) • XT-37 • H-19
(Helicopter) • T-35 • F-84F
• YC-130 • XP5Y
C-130A • XV-3 (Helicopter) • T-37 • XFV
Super Navion
S2F • R3Y
• RF-84F

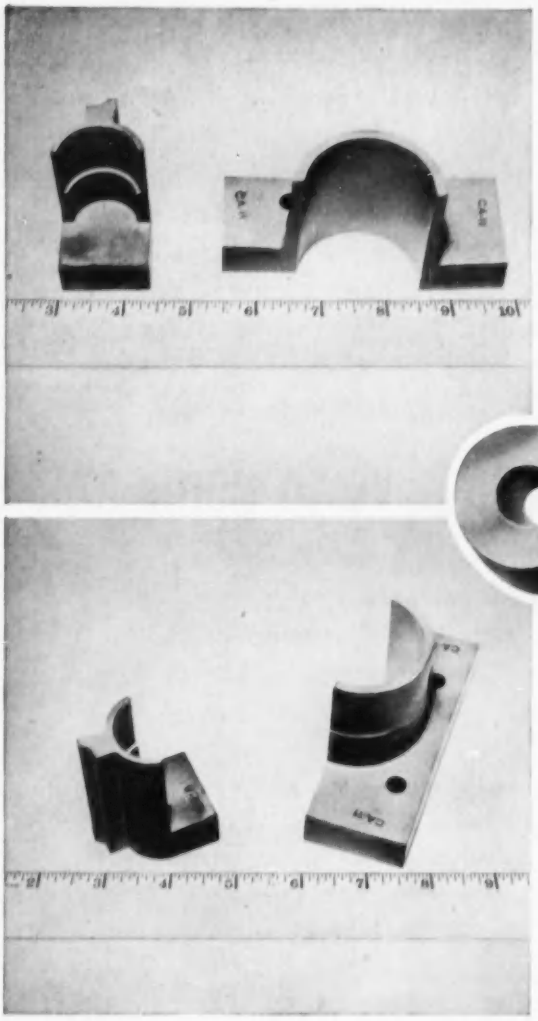
Reads like a roll call of American aviation, doesn't it? From small single-seaters to giant bombers and ponderous blimps, all have one thing in common—LORD bonded-rubber engine mountings to isolate power plant vibrations. This roll call indicates the past and present use of LORD engine mountings. As new milestones in aircraft propulsion are attained—in turboprop, jet and reciprocating—LORD will continue to prove its ability to produce new mountings with greater control over propeller disturbance and engine vibration. They will assure less flight fatigue, greater passenger comfort and protection to aircraft structure. Look to LORD for the best in vibration control.

LORD MANUFACTURING COMPANY • ERIE, PENNSYLVANIA

LORD
BONDED RUBBER

designers and producers of bonded rubber products since 1924

NEW YORK, N. Y. Circle 7-3326 • PHILADELPHIA, PA. LOcust 4-0147
CLEVELAND, OHIO SUperior 1-3242 • DAYTON, OHIO Michigan 8871
DETROIT, MICH. • TRinity 4-2060 • CHICAGO, ILL. Michigan 2-6010
DALLAS, TEXAS • Riverside 3392 • LOS ANGELES, CAL. • HOllywood 4-7593
"In Canada—Railway & Power Engineering Corporation Limited"



Look How You Can Save with PREFORMED CARMET®

DIE SECTIONS

these Blanks are preformed to a Finishing Allowance of .018"-.022" per side

Write for Your Copy:
CARMET CATALOG

Just out . . . 32 well-illustrated pages, containing data on all Carmet grades, and on Carmet blanks, tools, die sections, punches, draw die inserts, etc.; also special preforming to order.
● *Write for your copy.*

ADDRESS DEPT. SA-71

These tungsten carbide die sections are of Carmet CA-11, a special grade developed expressly for punches, dies, and other heavy shock applications where wear and abrasion resistance are required.

These blanks have a span of 1.315" with a wall thickness of only .046", but they were easily produced to close tolerances by AL's precision preform methods. All surfaces are clean, smooth and free from defects, requiring only a minimum amount of grinding to final dimensions.

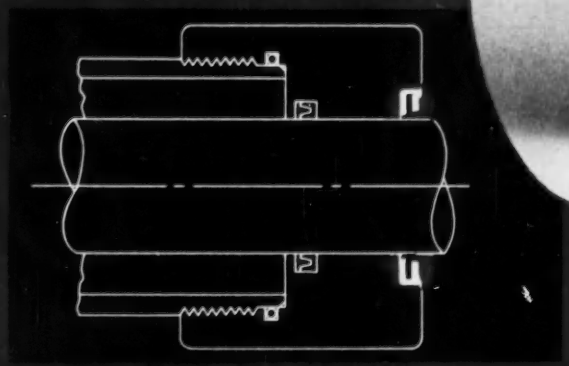
Carmet carbides can be accurately produced to practically any shape or size your designs may require, and can be supplied preformed as desired. Typical highly successful applications include inserts for drawing, heading, extruding and blanking dies; gauge and wear parts; pins; bushings; etc.

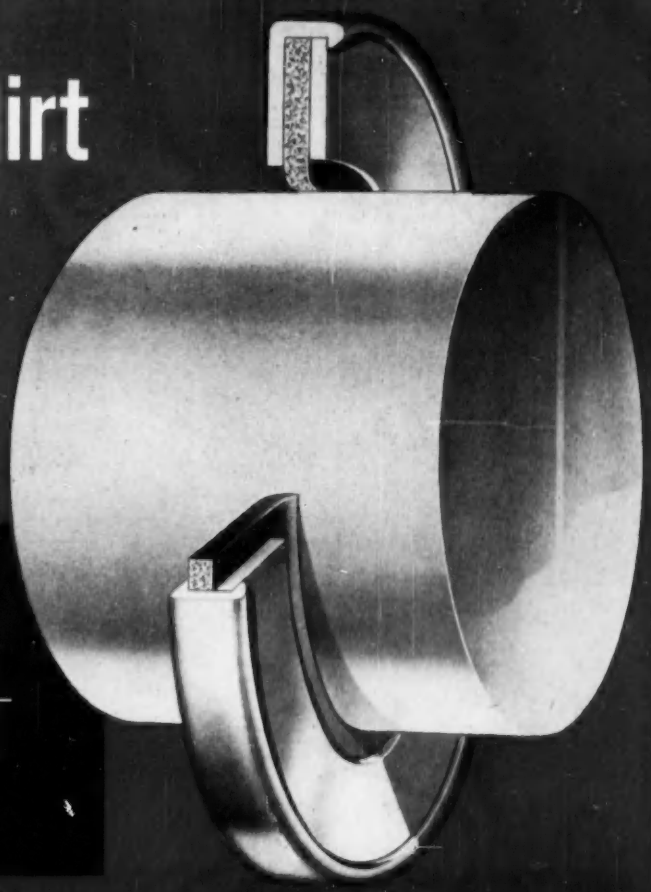
Find out, TODAY, how you can cut costs with preformed Carmet. Write or call *Allegheny Ludlum Steel Corporation, Carmet Division, Wanda and Jarvis Avenues, Detroit 20, Mich.*

For ALL your CARBIDE needs, call
Allegheny Ludlum
W&D 8330

AL® FINE TOOL STEELS SINCE 1854

Wipes out dirt for life!





WEAR-SAVERS THAT WON'T STEAL POWER

Hydraulic cylinder makers use Chicago Rawhide's Type G wiper seals for many reasons. Here's one: the special Sirvis leather wiper element holds its own lubricant—operates at low friction. This means negligible power loss. Another advantage: the Sirvis leather element will not trap grit and carry it—will not score the shaft. Years of dependable performance have demonstrated the ability of C/R Type G Oil Seals to exclude dirt, dust and moisture. They may be the answer to your problem, too. Write for your copy of "C/R Perfect Oil Seals."

C/R

PERFECT Oil Seals

More automobiles, farm and industrial machines rely on C/R Oil Seals than on any similar sealing device

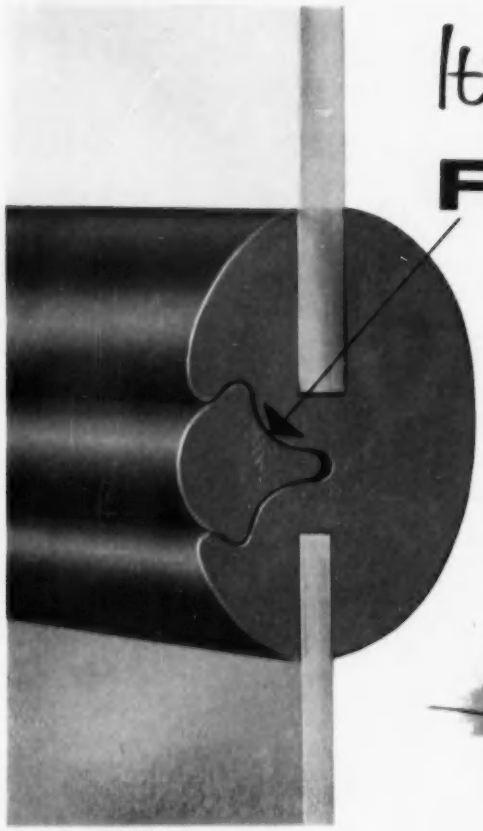
CHICAGO RAWHIDE MANUFACTURING COMPANY

1301 Elston Avenue OIL SEAL DIVISION Chicago 22, Illinois

IN CANADA: MANUFACTURED AND DISTRIBUTED BY SUPER OIL SEAL MFG. CO., LTD., HAMILTON, ONTARIO
EXPORT SALES: GEON INTERNATIONAL CORP., GREAT NECK, NEW YORK

Other **C/R** *products*

SIRVENE: (Synthetic rubber) diaphragms, boots, gaskets and similar parts for critical operating conditions • CONPOR: Controlled porosity mechanical leather packings and other sealing products • SIRVIS: Mechanical leather boots, gaskets, packings and related products.



It's this separate **FILLER STRIP**

that puts more pressure on the fence and the glass... providing a permanent leak proof seal!

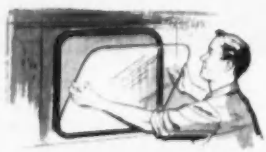
The filler strip makes possible these other Inland advantages!

If you're having trouble with windows and windshields that only slow up the rain, then you've probably looked longingly at a competitor's model and asked yourself . . . "how do they do it?" At first glance, their seals seem no different from your own . . . and yet—look closely. See that filler strip? That means they're using Inland's new self-sealing weather strip. No wonder they have no leak problems.

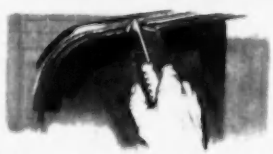
The installer compresses the strip *after* the glass is in place. No more forcing the glass into a groove. What's more, Inland weather strip is, by far, the easiest to install!

INLAND MANUFACTURING DIVISION
General Motors Corporation • Dayton, Ohio

FREEDOM OF DESIGN! No provision need be made for moldings, channels, binder strips or cement when designing with Inland Self-Sealing Weather Strip.



EASY GLASS REPLACEMENT! Less lost time for vehicles. A one-man job, broken glass can be replaced on the road, if necessary.



A POSITIVE SEAL! This filler strip puts more pressure on the fence and the glass—assures complete, positive weather proofing every time.

VERSATILITY! Ideal for vehicles, booths, trains, gasoline pumps, buildings, marine windows—for positive, permanent sealing of any window or panel!

INLAND MANUFACTURING

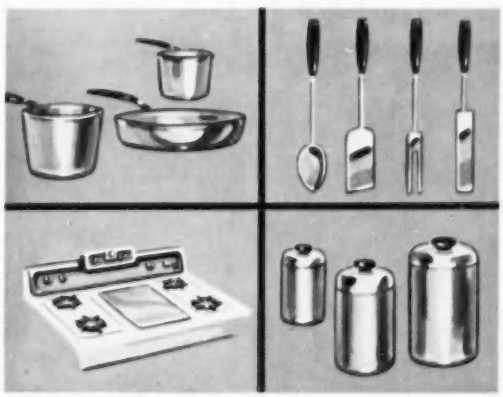
Self-Sealing

(PATENTED)

WEATHER STRIP

modern design specifies stainless steel

McLouth
STAINLESS
Steel
for the home



The lady agrees with the architect that her modern, cheerful, Stainless Steel kitchen will be the most beautiful room in the new house. Stainless Steel is the bright, long lasting metal that will not tarnish, is easy to clean and a joy to live with.

For the product you make today and the product you plan for tomorrow specify McLouth high quality sheet and strip Stainless Steel.

McLOUTH STEEL CORPORATION
Detroit, Michigan

MANUFACTURERS OF STAINLESS AND CARBON STEELS

Question:

What are the specifications for high performance transmission band lining?

ANSWER: Lining that combines these characteristics...

- It should offer a relatively high coefficient of friction
- It should resist frictional fade at high interface temperatures
- It must be durable, resist wear and deformation at the anchor end
- It must not deteriorate in hot transmission oil
- It must withstand high bonding temperatures without blistering
- In flat strip form, it must be capable of being machined without developing a rough or fuzzy surface
- In strip form, it must be flexible enough to assume the band curvature without breaking

Question:

Who has facilities to work with you in developing bands expressly for your needs?

Molded or woven transmission band lining can be supplied in rigid segments or flexible grooved strips.

ANSWER: Johns-Manville can offer outstanding engineering skill and research facilities plus versatile production processes

◀ Today, automobile manufacturers endorse J-M transmission bands as standard equipment. Car builders are finding too, that J-M's development facilities can aid in solving problems in designing improved transmissions.

Experience, skill and research stand back of the complete line of J-M brake linings, clutch facings and transmission bands. Our engineering staff and superbly equipped laboratory are at your service, too . . . ask your J-M representative or write to Johns-Manville, Automotive Equipment Department, 832 Fisher Bldg., Detroit 2, Michigan.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville ASBESTOS FRICTION MATERIALS

THIS PUMP OPENED NEW DIESEL MARKETS...

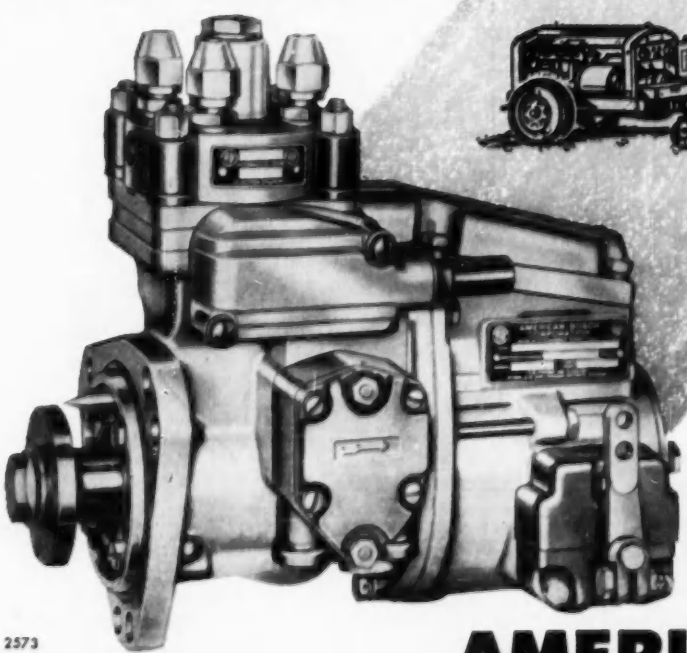
THE AMERICAN BOSCH "PSB"

American Bosch's development of the PSB single-plunger pump made it possible for engine manufacturers to produce the smaller, lower-cost Diesels which have opened up new markets for Diesel power. You see it serving everywhere —on efficient Diesels that power farm tractors, compressors, generating sets, boats and trucks in ever-increasing numbers.

Today, more Diesel engine manufacturers are using the American Bosch PSB as standard equipment than ever before. It's easy to see why —for the PSB gives both the engine manufacturer and the user a simplified, compact, lower-cost pump with a *proven* record of outstanding performance and dependability *plus* ease of servicing and low maintenance expense.

The PSB is a product of American Bosch's continuing program of research and development. It stands as a significant contribution to the progress of the Diesel.

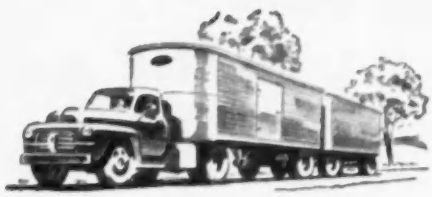
AMERICAN BOSCH, Springfield 7, Mass.



2573

AMERICAN BOSCH

EATON 2-SPEED AXLES keep Trucks on the Job- Reduce Maintenance Costs

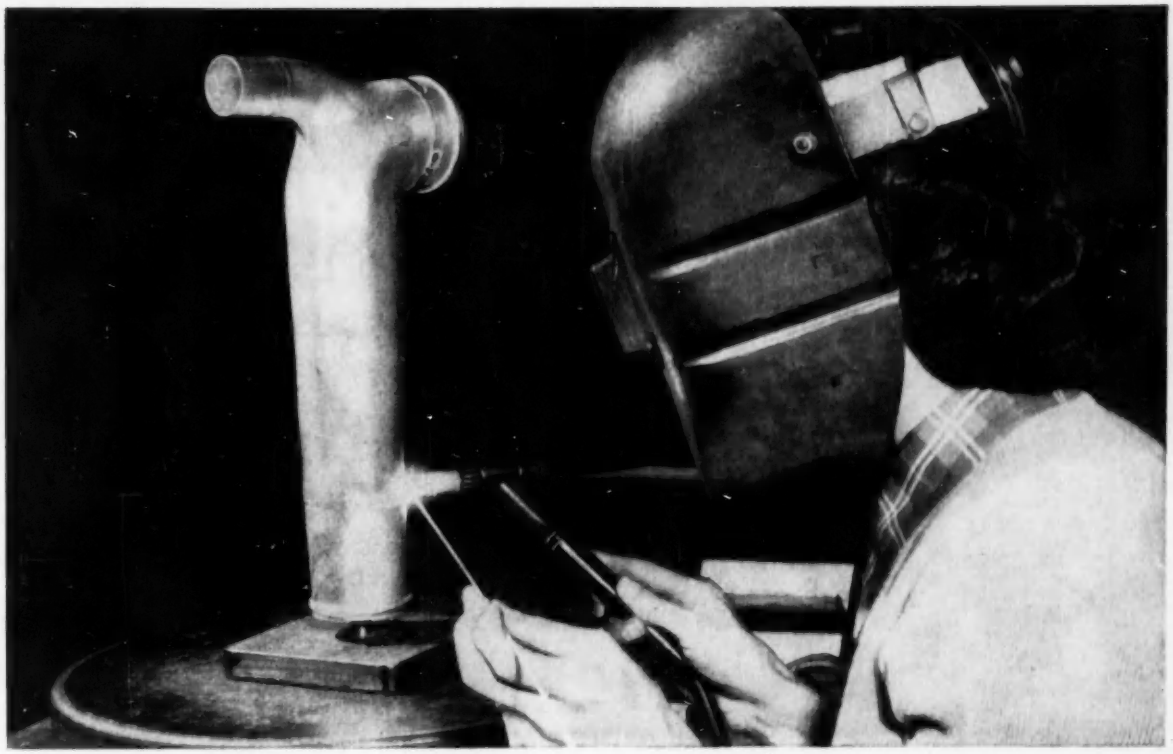


By providing a gear ratio best suited for each road and load condition, Eaton 2-Speed Axles permit engines to work in their most efficient and economical speed range, reducing stress and wear on operating truck parts. Truck maintenance is reduced, trucks deliver more on-the-job hours. In addition, because of Eaton's exclusive planetary design, forced feed lubrication, and extra rugged construction, there's less maintenance on the axle itself. When axle repair is required, Eaton's down-to-earth design makes the work quick, easy, and economical. Trucks with Eaton 2-Speed Axles last longer, earn more at lower cost, are worth more on the trade-in.

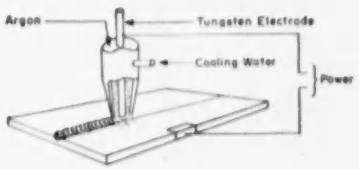
More than Two Million Eaton Axles in Trucks Today!

EATON AXLE DIVISION
MANUFACTURING COMPANY
CLEVELAND, OHIO

PRODUCTS: Sodium Cooled, Poppet, and Free Valves • Tappets • Hydraulic Valve Lifters • Valve Seat Inserts • Jet Engine Parts • Rotor Pumps • Motor Truck Axles • Permanent Mold Gray Iron Castings • Heater-Defroster Units • Snap Rings Springtites • Spring Washers • Cold Drawn Steel • Stampings • Leaf and Coil Springs • Dynamatic Drives, Brakes, Dynamometers



Sound Welds in 33 Seconds ...by HELIARC Welding



Each of the six appendages of these 52S aluminum aircraft manifolds is HELIARC welded to the tubular main section in from 20 to 45 seconds . . . The spatter-free, flux-free HELIARC welds need no cleaning or finishing—costs are kept at a minimum.

The parts are aligned in a special jig, and tack-welded in position using a lightweight HELIARC HW-9 torch . . . The finished welds are made while the parts revolve on an electrically operated turntable controlled by a foot-switch. Since each weld is completed in less than a minute, production rates are high . . . Here are some of the advantages of HELIARC welding:

- Joins nearly all commercial metals including non-ferrous and high temperature alloys.
- Heat highly concentrated within the area of the weld minimizes distortion.
- Makes all type joints in all positions on metals .020 in. and thicker.
- Portable manual equipment, and semi-automatic and automatic units for all job needs . . . Semi-automatic hand-guided HELIARC welding attains speeds up to 50-in. per minute.

Start saving now—call your local LINDE representative for more information and ask for Form 7942, "Modern Methods of Joining Metals."

Linde Air Products Company
A Division of Union Carbide and Carbon Corporation
30 East 42nd Street UCC New York 17, N. Y.
Offices in Other Principal Cities
In Canada: LINDE AIR PRODUCTS COMPANY
Division of Union Carbide Canada Limited, Toronto

The terms "Linde" and "Heliarc" are registered trade-marks of Union Carbide and Carbon Corporation.

Linde Trade-Mark

ANOTHER

Spicer unit for efficient power transmission

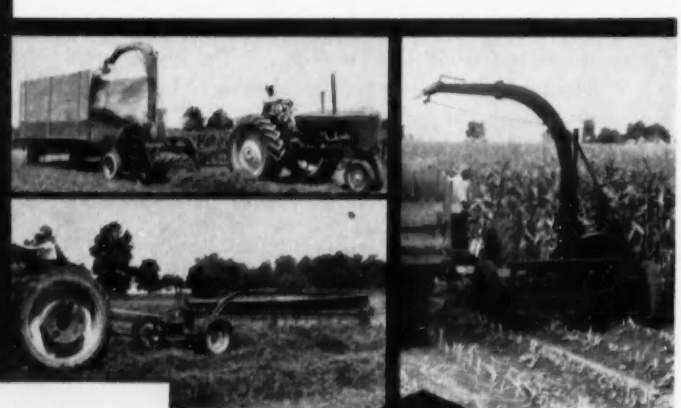
IN AGRICULTURE AND INDUSTRY...

Increasing automation of farm and industrial equipment now requires many complex propeller shaft applications in

Post Hole Diggers	**Hammer Mills**	**Elevators**
Manure Spreaders	**Pumps**	**Shredders and Cutters**
Mowing Machines	**Ensilage Cutters**	**Sprayers**
Hay Balers	**Self-Unloading Wagons**	**Hay Rakes**

The problems covering these installations can be solved by Spicer experience in all kinds of power transmission . . . for all types of automotive vehicles.

Spicer originated and developed the automotive universal joint and drive line assembly. Spicer has the men . . . the materials . . . and the machinery to meet the requirements of power transmission units in your equipment.



The Spicer Telescoping Propeller Shaft Assembly has a non-rotating hinge angle to 90°, and clearance for momentary angles up to 60°.

Spicer

DANA CORPORATION · TOLEDO 1, OHIO

THE NEW

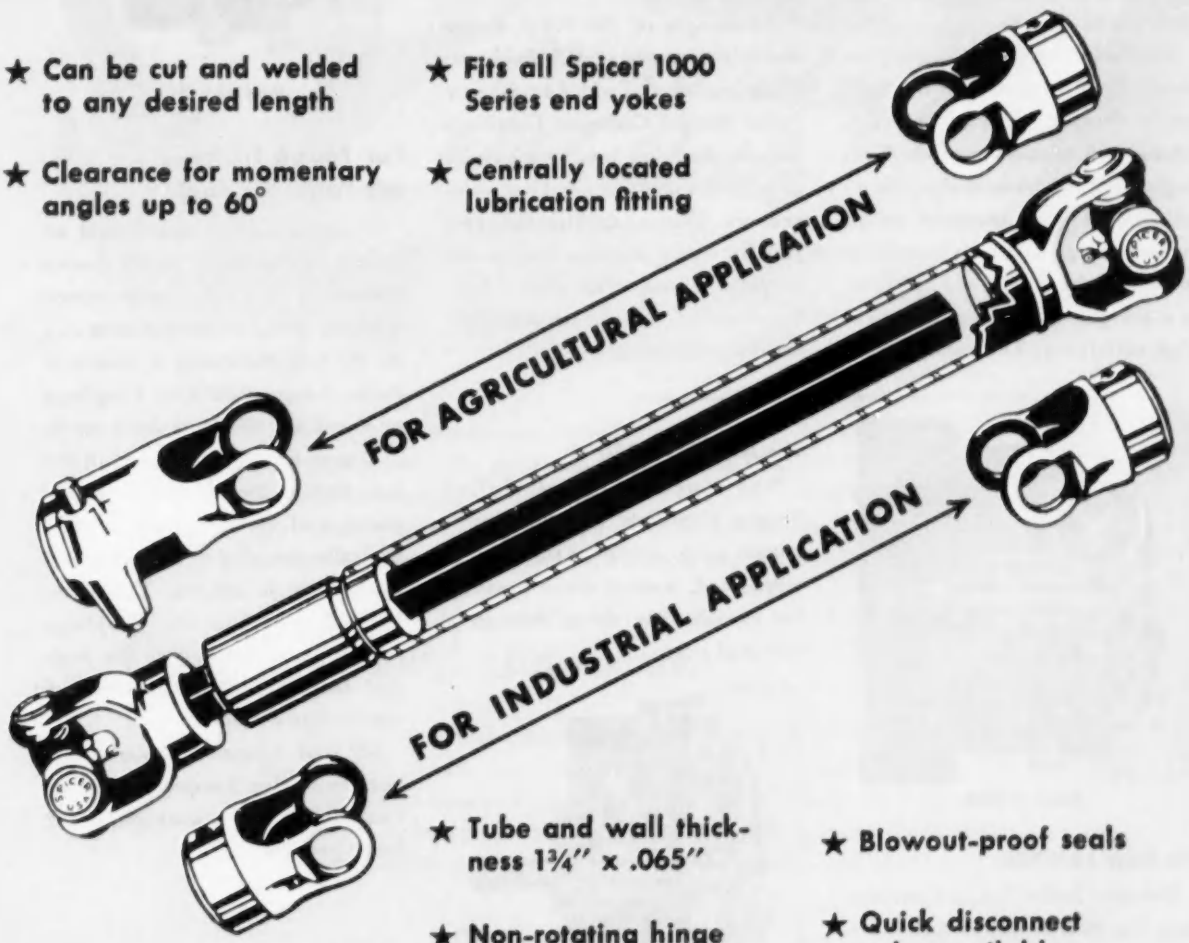
Spicer Telescoping Propeller Shaft Assembly

★ Can be cut and welded to any desired length

★ Fits all Spicer 1000 Series end yokes

★ Clearance for momentary angles up to 60°

★ Centrally located lubrication fitting



★ Tube and wall thickness 1¾" x .065"

★ Non-rotating hinge angle to 90°

★ Swing diameter 1½"

★ Blowout-proof seals

★ Quick disconnect yoke available

★ Needle type bearings

SPICER PRODUCTS: TRANSMISSIONS • UNIVERSAL JOINTS • PROPELLER SHAFTS • AXLES • TORQUE CONVERTERS • GEAR BOXES • POWER TAKE-OFFS • POWER TAKE-OFF JOINTS • RAIL CAR DRIVES • RAILWAY GENERATOR DRIVES • STAMPINGS • SPICER and AUBURN CLUTCHES • PARISH FRAMES

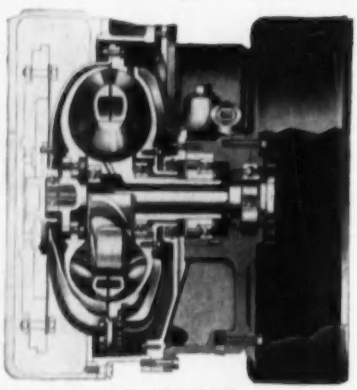
Fuller announces 3 new torque converter couplings

. . . designed for a wide variety of industrial applications

Three new Fuller Torque Converter Couplings nominally rated at 280 foot pounds of torque are now available for increasing work capacity in a wide variety of industrial applications.

The Fuller Industrial Torque Converter Couplings consist of three simple elements; impeller or pump, runner, and reaction member. With single stage two phase design, the reaction member is mounted on an overrunning clutch which permits rotation with the runner, and operation as a straight hydraulic coupling for high efficiency. The change from 2.1:1 conversion stage operation to straight hydraulic coupling stage and back is automatic, depending only upon the amount of torque required in the drive line.

Advantages of the 2.1:1 torque multiplication and smooth fluid coupling operation provided by the new Fuller Torque Converter Couplings include obtaining faster work cycles . . . with less downtime and less maintenance. Typical applications are: fork lift trucks, winches, loaders, self propelled cranes, truck cranes, lumber carriers . . . and diesel and gasoline locomotives.



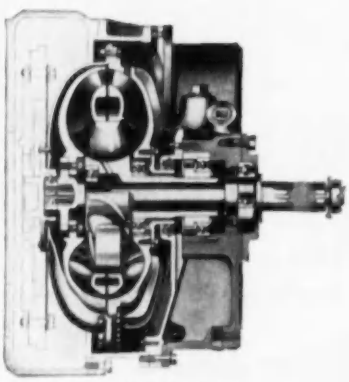
Model 12-T-280

The New 12-T-280

This new Fuller Torque Converter Coupling incorporates an SAE No. 3 clutch housing behind the converter. The output shaft is flanged for attachment of a single plate clutch flywheel.

The New 12-U-280

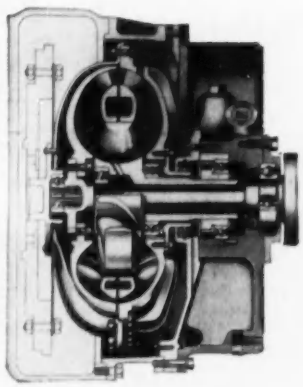
The Model 12-U-280 Fuller Torque Converter Coupling incorporates a 1½" ten-spline shaft on the output end, without clutch housing, for straight line drives through a universal joint.



Model 12-U-280

The New 12-H-280

A new model which incorporates a flange at the output shaft, for attachment of industrial type couplings.



Model 12-H-280

For Tough Tasks— It's Fuller by Far!

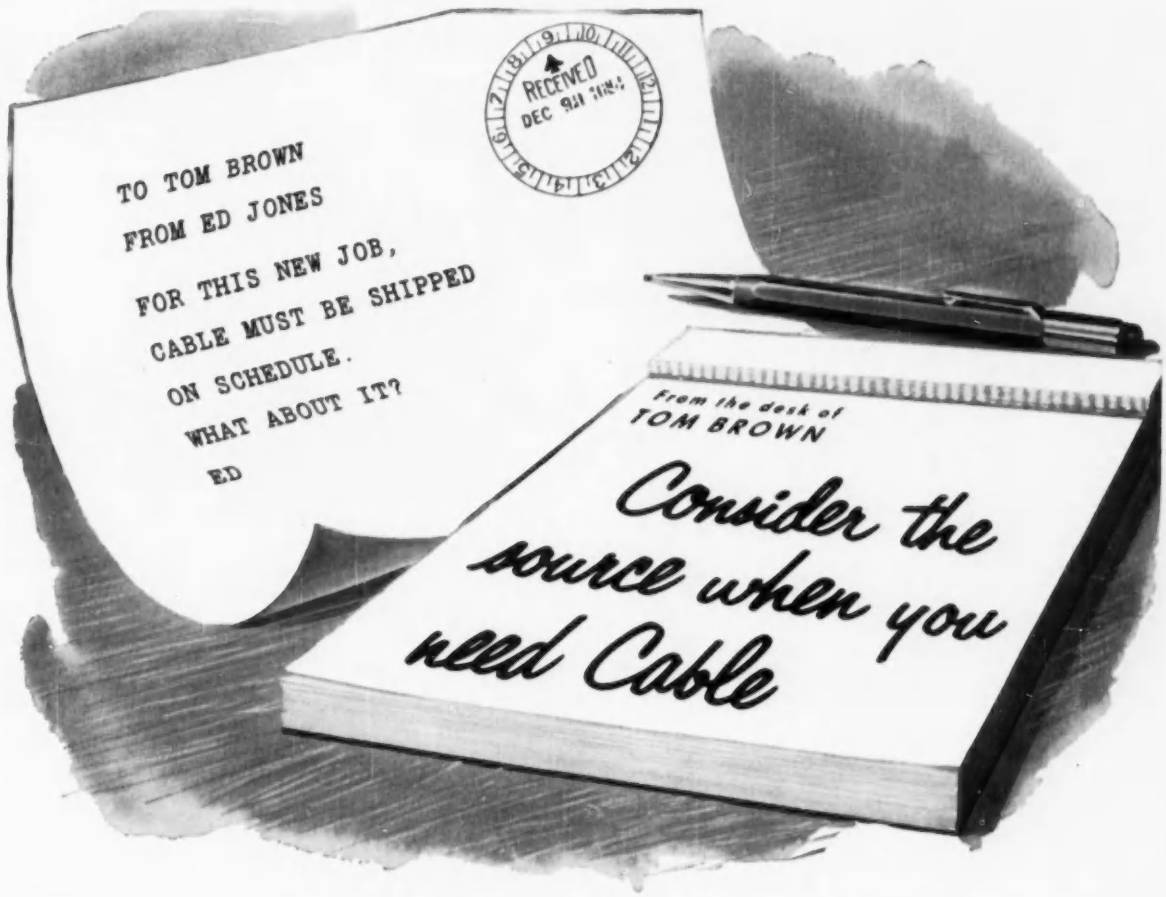
Where frequent start-and-stops, or heavy, intermittent shock loads threaten to overwork engines, transmissions, axles, brakes and tires . . . use the fluid cushioning of these new Fuller Torque Converter Couplings to *absorb* and *eliminate* shock loads.

Torque demand is matched to the load through the 2.1:1 torque multiplication of the converter . . . automatically changing to fluid coupling as the load is reduced. These new Fuller Torque Converter Couplings *keep* engines operating in the high rpm range under all conditions of vehicle load and speed.

See your equipment dealer *today.* Specify Fuller Torque Converter Couplings in your new equipment for better performance.

FULLER MANUFACTURING COMPANY
TRANSMISSION DIVISION • KALAMAZOO, MICH.

Unit Drop Forge Div., Milwaukee 1, Wis. • Shuler Axle Co., Louisville, Ky. (Subsidiary) • Sales & Service, All Products, West. Dist. Branch, Oakland 6, Cal. and Southwest Dist. Office, Tulsa 3, Okla.



Prompt, dependable delivery schedules are important to any manufacturer. And promptness is the natural result of Packard Electric's flexible, carefully regulated production schedules. Add to this the high quality of Packard cable that consistently meets or exceeds applicable specifications, and you have two of the many benefits you can enjoy through dealing with Packard Electric.

Consider Packard as a source

In addition to facilities sufficient to manufacture *daily* more than 7,000,000 feet of cable and more than 800,000 wiring assemblies, Packard Electric can offer you the services of its large engineering staff to help solve any cable problem. These benefits have often meant big savings for Packard customers. It is quite possible that they could be of equal value to you.

GM GENERAL MOTORS Packard

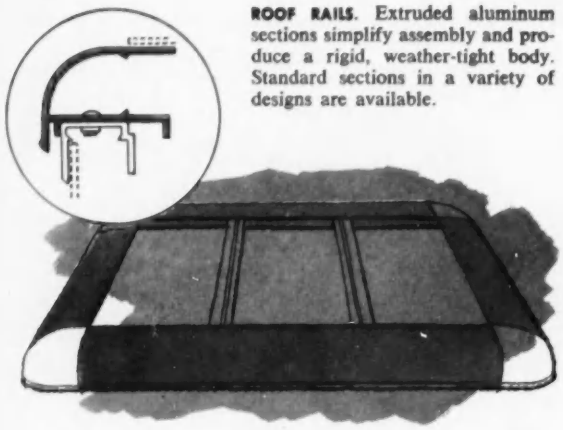
Packard Electric Division, General Motors, Warren, Ohio
Offices in Detroit, Chicago, and Oakland, California

AVIATION, AUTOMOTIVE AND APPLIANCE WIRING

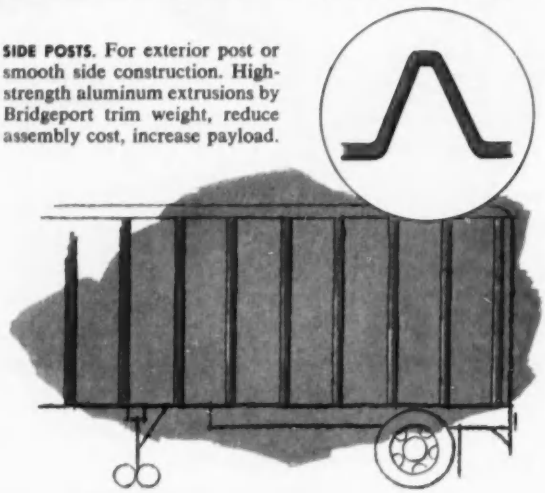
No matter what the shape of your design—

BRIDGEPORT ALUMINUM

can extrude it!



ROOF RAILS. Extruded aluminum sections simplify assembly and produce a rigid, weather-tight body. Standard sections in a variety of designs are available.



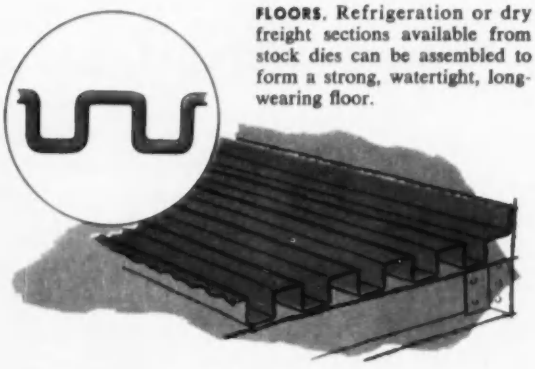
SIDE POSTS. For exterior post or smooth side construction. High-strength aluminum extrusions by Bridgeport trim weight, reduce assembly cost, increase payload.

The sections you see illustrated are some of the many aluminum extrusions that Bridgeport is producing for progressive-minded truck and trailer body builders. These extrusions are helping to trim body weight, increase payload, and produce a tighter, more rigid assembly.

These high-strength trailer sections are typical of the wide range of shapes in all extrudable alloys that Bridgeport is now producing for a host of industries from aircraft to architectural. These shapes include both standard stock sections and extrusions specially engineered to meet design requirements and physical properties.

When you deal with Bridgeport you get these important "extras"... the capacity of a big producer—16 presses in an 800,000 square foot plant... the flexibility of a completely integrated operation from die to finished extrusions... technical help when you need it... and consistent high quality resulting from careful inspection and control at every step along the way.

Put Bridgeport extrusions and experience to work for you in making your product easier to make and easier to sell. Our nearest Sales Office is ready to give you complete information on Bridgeport extrusions.



FLOORS. Refrigeration or dry freight sections available from stock dies can be assembled to form a strong, watertight, long-wearing floor.

Bridgeport

For the very latest in

BRIDGEPORT ALUMINUM

EXTRUSIONS, DIE AND HAND FORGINGS

Bridgeport Brass Company, Aluminum Division, Bridgeport 2, Connecticut

Offices in Principal Cities

You get *something extra* when you call in Cleveland Graphite Bronze

Cleveland Graphite Bronze has become the leading maker of sleeve bearings and bushings because of the "extras" we give our customers.

One extra we give our customers is ***outstanding engineering:*** fundamental research at the Clevite Research Center; original thinking at the design stage; searching thoroughness in testing and development. To follow through, we have a fast, able team of field engineers, working on specialized problems in our customers' plants.

With this concentration on engineering, we have introduced almost all the real improvements in our industry in the past 35 years, and have put them to work for the leading manufacturers in half a dozen different fields.

C. G. B. customers are getting the best advice, and getting it first. Are you missing out on it?

CLEVITE
CORPORATION

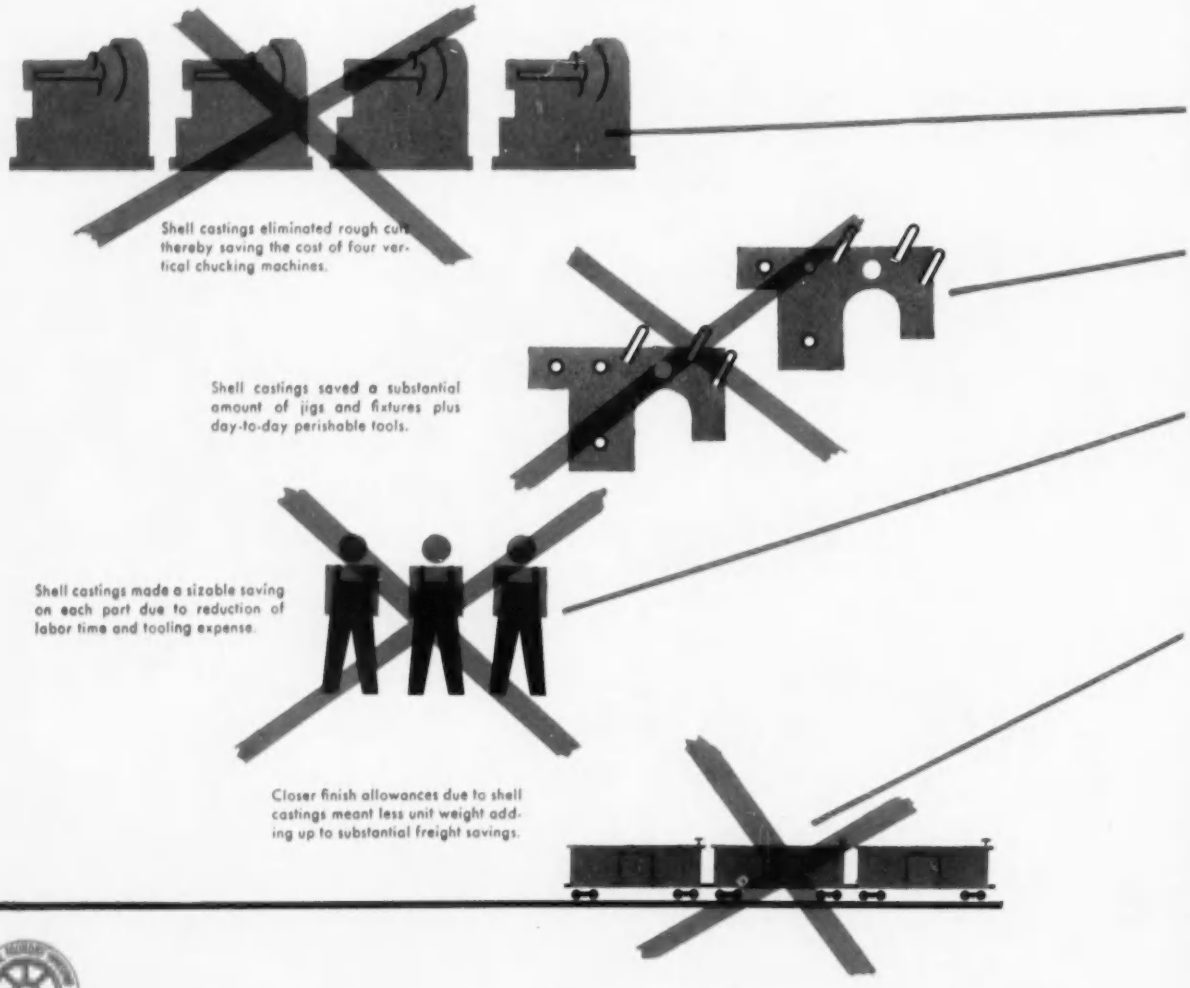
The Cleveland Graphite Bronze Co.

Sleeve bearings and bushings and other mass-precision metal parts

LOOK AT THESE

MADE ON THIS STATOR WITH CENTRAL FOUNDRY

By having it shell-cast by Central Foundry Division, savings on this Stator Blade Carrier were effected in six figures. With the shell casting process finish allowances were reduced so that preliminary rough machining was eliminated and only finishing machine operations were required. Thus machinery, tools, and man-hours and even freight were substantially reduced. The savings made on this grey iron part are typical of what uniform Central Foundry Division shell castings can do for you. Obviously, savings are the greatest . . . as they were here . . . when the original design is planned for a shell casting, before tooling up.



Shell castings eliminated rough cuts thereby saving the cost of four vertical chucking machines.

Shell castings saved a substantial amount of jigs and fixtures plus day-to-day perishable tools.

Shell castings made a sizable saving on each part due to reduction of labor time and tooling expense.

Closer finish allowances due to shell castings meant less unit weight adding up to substantial freight savings.

54

CENTRAL FOUNDRY DIVISION

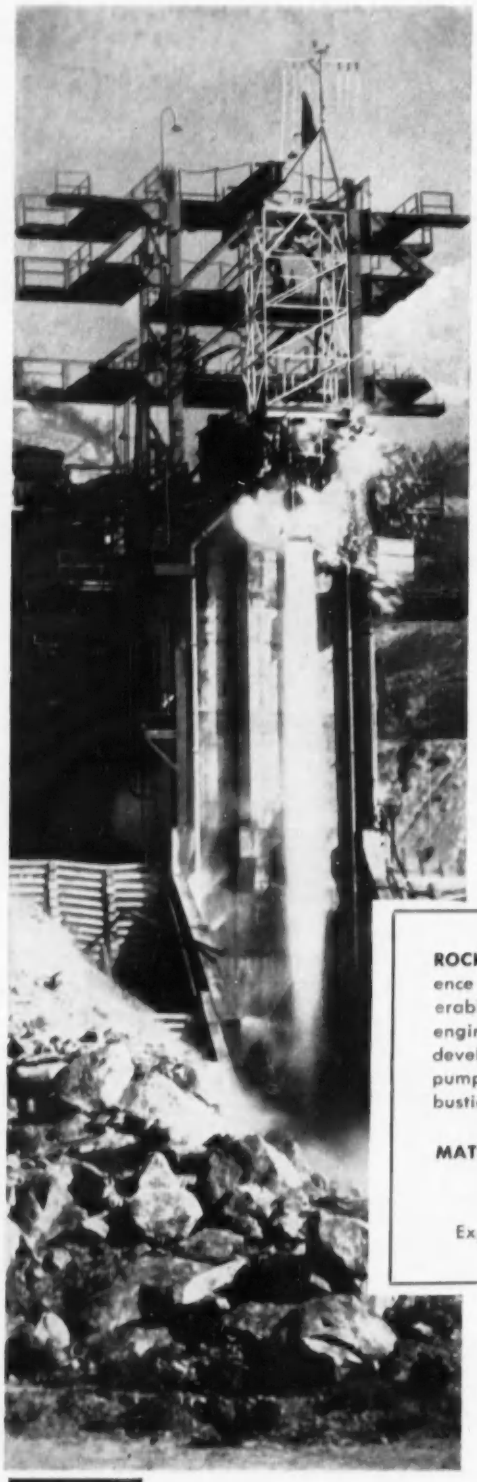
$AVING$

BLADE CARRIER SHELL CASTINGS

There are many advantages from Central Foundry Division shell castings. Parts too difficult in contour for the green sand method can be held to close dimensional uniformity on a production basis. The improved casting surfaces and uniformity of a shell casting often eliminate machining on non-functional areas. Excessive tool wear caused by sand particles in the surface is eliminated because the thin shell of sand used as a mold is bonded by a thermo-setting plastic which results in clean, sand-free castings.

For further information about either shell or sand casting or about any type of castings in grey iron, malleable iron or ArmaSteel write for descriptive literature . . . or request personal help from our experienced engineers, without obligation.

GENERAL MOTORS CORPORATION • SAGINAW, MICHIGAN • DEPT. 18



PIONEER AND LEADER IN ROCKET ENGINE DESIGN AND DEVELOPMENT

North American's Propulsion Center Offers

CAREERS FOR ENGINEERS IN ROCKET ENGINES

NOW, you can check on positions in the engine industry with an assured future—rocket engine design and development. North American . . . the company that has built more airplanes than any other company in the world . . . is also a pioneer in rocket engine design and development. Today, North American is the acknowledged leader in large liquid rocket engines.

YOU can be part of this success . . . team up with the top engineers in rocket engine design and development. Your ideas and work are given unusual recognition at North American . . . our liberal Patent and Suggestion Award Programs prove this. A fine Retirement Plan and other personal benefits are yours also at North American.

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ROCKET ENGINE ENGINEERS: Experience on rocket engine design preferable, or internal combustion engine experience, or design and development experience on turbines, pumps, engine instrumentation, combustion devices, engine controls.

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MATHEMATICIANS · MECHANICAL ENGINEERS · ELECTRICAL ENGINEERS
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STANDARDS ENGINEERS & DESIGN CHECKERS

Experienced in any field, with a desire to get into rocket engine design.

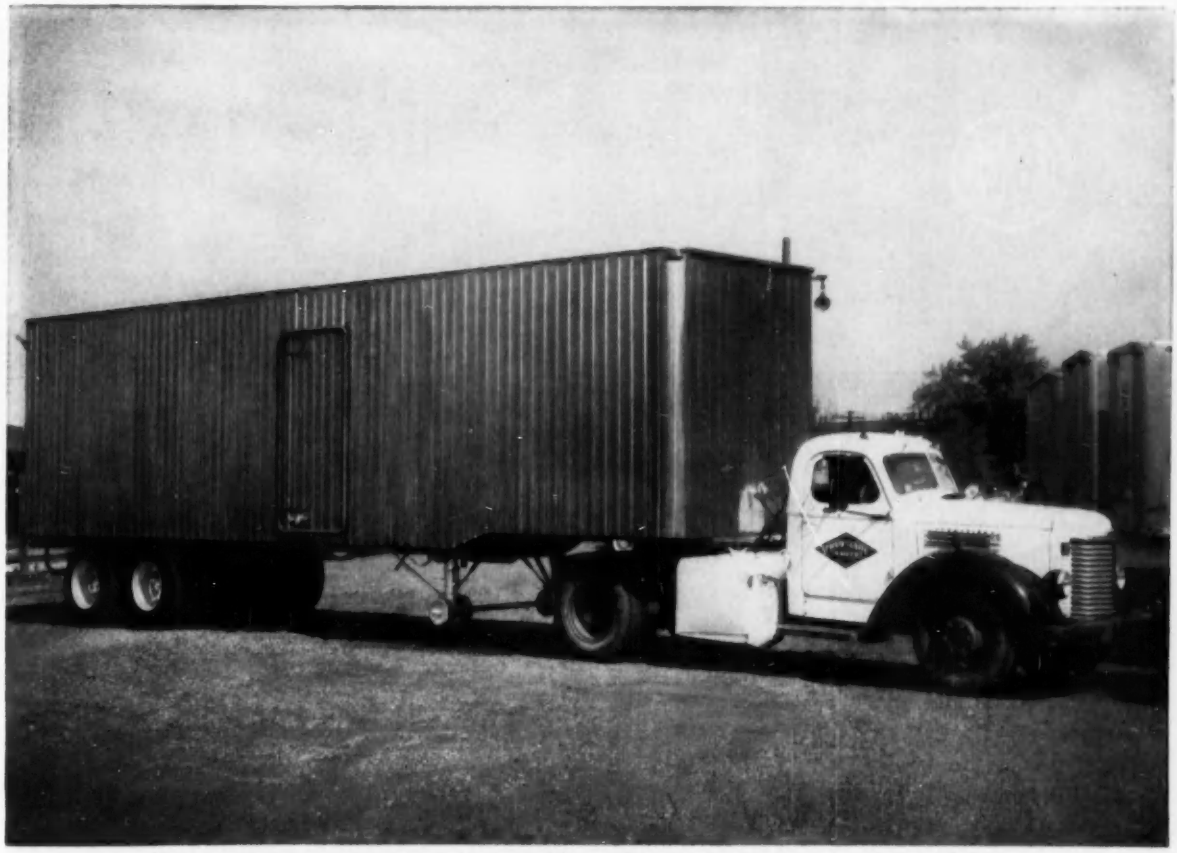
WRITE TODAY:

Mr. Grant Baldwin, Engineering Personnel Office, Dept. SAE, corner Deering and Gault, Canoga Park, California.

ENGINEERING AHEAD FOR A BETTER TOMORROW

NORTH AMERICAN AVIATION, INC.

*TRADEMARK



Silvery white under all atmospheric conditions, chromium-nickel stainless steels offer permanent beauty and unsurpassed performance in the freight hauling field. Type 302 stainless steel with ultimate tensile strength of 125,000 to 150,000 psi is utilized in this new trailer, produced by Fruehauf Trailer Co., Detroit 32, Mich. The stainless steel body components for this new line are designed and furnished by The Budd Co., Philadelphia 15, Pa.

Stainless Steel in new Fruehauf design allows 94" inside width . . . up to 35% more space

HERE'S A STRIKING EXAMPLE of the way the Fruehauf Volume Van enlarges trailer cargo space. It's done with chromium-nickel stainless steel.

In the unit shown above, Fruehauf specifies sidewalls of corrugated stainless steel panels, SHOT-WELDED together for increased overall strength, along with a corrugated stainless steel roof.

This use of thin-gauged chromium-nickel stainless permits an inside width of 94 inches, as well as increased length and height, with no sacrifice of structural strength.

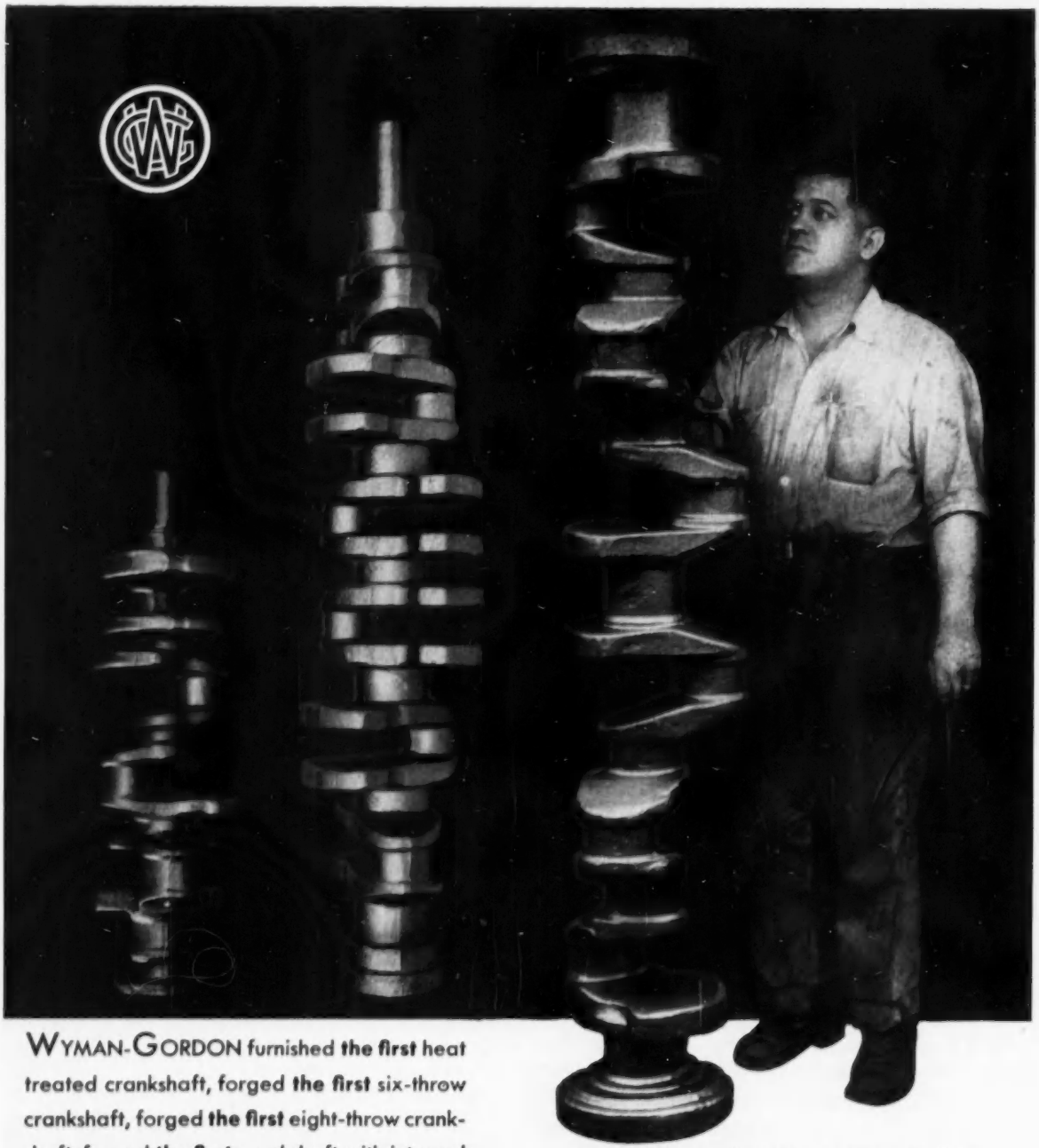
In addition, the stainless steel sidewalls and roof never need painting. And they add years of earning power to these vans, because the chromium-nickel alloy resists attack by the atmosphere and practically all types of loading.

Moreover, it stands up to impact, wear and abrasion. In fact, the builder of these trailers declares that no stainless steel Fruehauf equipment has ever worn out.

So, specify stainless steels to trim deadweight, increase payload, and get maximum on-the-road use of *your* vehicles. You can draw, spin, forge, weld, solder, punch, shear or bend these nickel alloyed steels.

Leading steel companies produce austenitic chromium-nickel stainless steels in all commercial forms. A list of sources of supply will be furnished on request.

INCO **THE INTERNATIONAL NICKEL COMPANY, INC.** 67 Wall Street New York 5, N.Y.



WYMAN-GORDON furnished **the first** heat treated crankshaft, forged **the first** six-throw crankshaft, forged **the first** eight-throw crankshaft, forged **the first** crankshaft with integral counterweights, and today forges a larger quantity and a greater variety of crankshafts than any other company in the world.

In a crankshaft there is no substitute for a forging, and in a forging there is no substitute for Wyman-Gordon quality and experience.

Crankshaft forgings illustrated, left to right, for V-8 passenger car, diesel truck and heavy tractor engines

WYMAN-GORDON CO.

Established 1883

FORGINGS OF ALUMINUM • MAGNESIUM
STEEL • TITANIUM

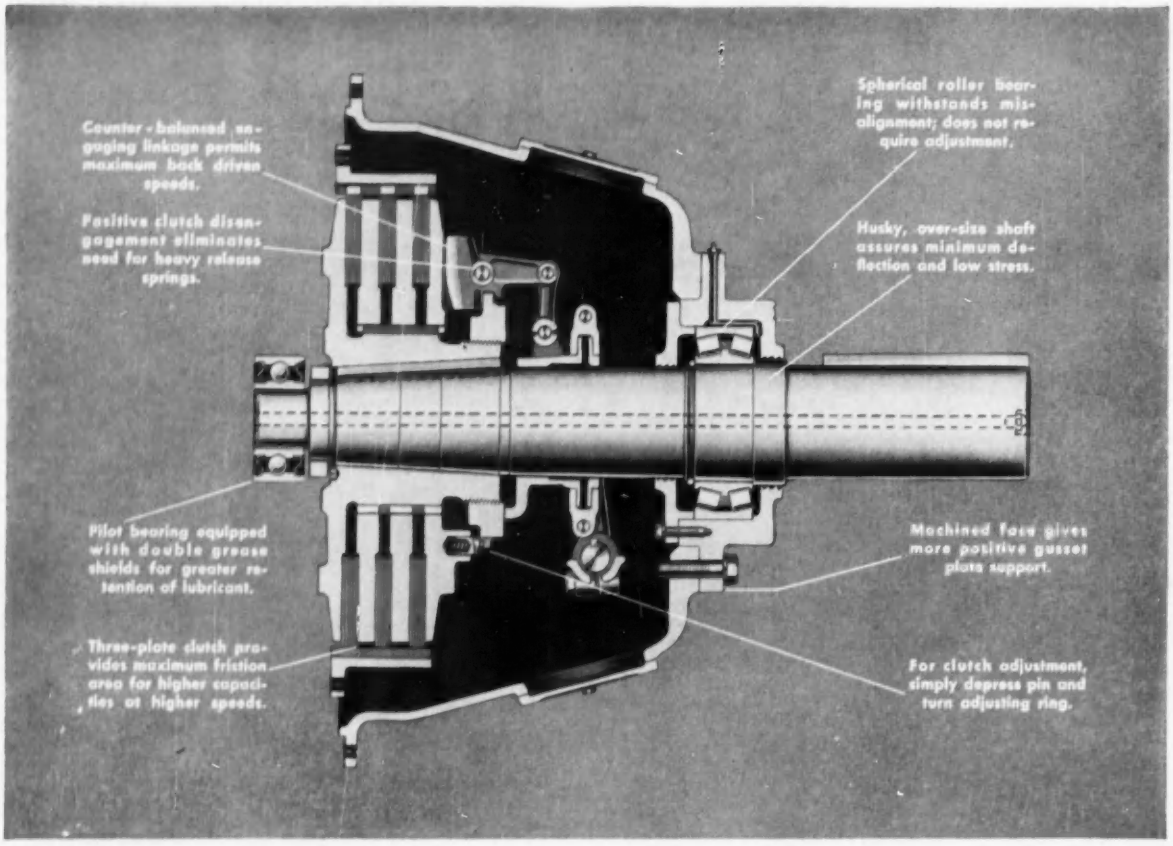
WORCESTER 1, MASSACHUSETTS
HARVEY, ILL. • DETROIT, MICH.

NEW

The famous MECHANICS Roller Bearing UNIVERSAL JOINT design now is available in a new SIZE with small swing DIAMETER and greater CAPACITY — for modern cars with LOW floor boards and MORE powerful engines. This new MECHANICS drive line is engineered to meet the specific needs for torque, size, weight, balance, angularity, runout, safety, lubrication, assembly and service that must be overcome by today's automotive designers. Let us show you how this latest MECHANICS Roller Bearing UNIVERSAL JOINT improvement will fit into *your* next model.

MECHANICS UNIVERSAL JOINT DIVISION
Borg-Warner • 2022 Harrison Ave., Rockford, Ill.

MECHANICS
Roller Bearing BW
UNIVERSAL JOINTS
For Cars • Trucks • Tractors • Farm Implements • Road Machinery • Aircraft • Tanks • Busses and Industrial Equipment


Counter-balanced engaging linkage permits maximum back driven speeds.
Positive clutch disengagement eliminates need for heavy release springs.
Pilot bearing equipped with double grease shields for greater retention of lubricant.
Three-plate clutch provides maximum friction area for higher capacities at higher speeds.
Spherical roller bearing withstands misalignment; does not require adjustment.
Husky, over-size shaft assures minimum deflection and low stress.
Machined face gives more positive gusset plate support.
For clutch adjustment, simply depress pin and turn adjusting ring.

A new Power Take-Off for higher-speed, higher-horsepower engines

Here is the all-new Twin Disc Model SP-318 heavy-duty Friction Power Take-Off—designed and engineered especially to meet the extra requirements of the new engines in the 350 to 375 hp range, operating up to 1800 rpm.

Extremely compact for its capacity, the new Twin Disc Power Take-Off is provided with an S.A.E. #0 flywheel housing. With triple driving plate construction, it assures ample friction surfaces to withstand high horsepower loads. And with solid driving plates, the new PTO effectively permits higher safe permissible speeds.

The pilot bearing of the new Power Take-Off is composed of a single row of balls, operating in bearing races of double-row width . . . providing improved accommodation of minor misalignment inherent in installations of this nature. Pilot bearings of this type provide additional space for lubricant, which is more effectively retained by the double grease shield construction. Although this construction is usually referred to as "sealed for life," the clutch shaft is drilled to provide for relubrication of the pilot bearing in the usual manner.

Another outstanding feature of the new Twin Disc Power Take-Off is the use of a spherical bearing which does not require adjustment. With its inherent ability to permit angularity, the spherical bearing is more resistant to overload and destructive forces resulting from heavy side loads.

For complete information on the new Twin Disc SP-318 Friction Power Take-Off (and the SP-314, a smaller model of the same new design, for engines in the 225 hp range operating at 2200 rpm), write to the Twin Disc Clutch Company, Racine, Wisconsin.

TWIN DISC

TWIN DISC

Friction Clutches and Fluid Drives

TWIN DISC CLUTCH COMPANY, Racine, Wisconsin
Hydraulic Division, Rockford, Illinois

Best Buy on the Market

BENDIX-WESTINGHOUSE AIR BRAKES

Preferred by America's Leading Fleet Operators

MR. ROBERT E. LEE
President, Lee Way Motor Freight, Inc.

From his company's recently constructed million dollar General Office and Terminal Building in Oklahoma City, Oklahoma, Mr. Lee directs a modern system of nearly 1000 units of mobile equipment serving over 700 cities in Oklahoma, Texas, Kansas, Missouri and New Mexico. Through a subsidiary, Sooner Freight Lines, Mr. Lee's company also serves an additional 196 cities in the western half of Oklahoma. Mr. Lee, one of the Southwest's best known transportation executives, states:

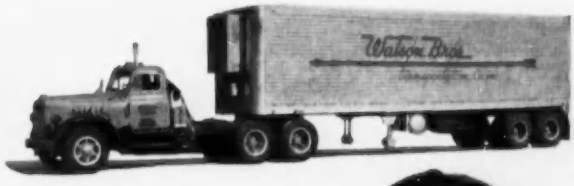
"In our 20 years in business

We've bought 2,100 trucks

AND WHEN IT COMES TO AIR BRAKES, WE PREFER

Bendix-Westinghouse!"

THE WORLD'S MOST TRIED AND TRUSTED AIR BRAKES



MR. FAY V. WATSON
President, Watson Bros. Transportation Co., Inc.

From executive offices in Omaha, Nebraska, Mr. Watson heads a company whose vast fleet, in 1954, travelled a distance equivalent to over six times around the world every 24 hours! This mileage was rolled up by 2400 modern highway units operating over 16,000 miles of certified interstate routes stretching west from Chicago and St. Louis to the Pacific Coast, and from St. Paul, Minnesota, in the north to Kansas City in the south. Mr. Watson, a veteran transportation executive states . . .

"During our 28 years in business

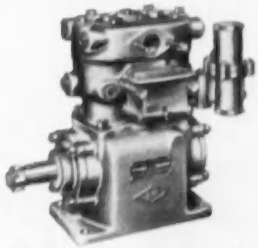
We've bought 5,000 trucks

AND WHEN IT COMES TO AIR BRAKES, WE PREFER

Bendix-Westinghouse!"

THE WORLD'S MOST TRIED AND TRUSTED AIR BRAKES

As designers and producers of trucks for America's highway transportation industry, you naturally try to build into your models all those features which will give your product an edge over competition. When it comes to brakes then, why not equip your trucks with the air brakes America's leading truckers know and prefer—Bendix-Westinghouse! Yes, for 25 years Bendix-Westinghouse Air Brakes have been first choice of truck operators everywhere, consistently outselling all other makes of air brakes combined! Take advantage of this overwhelming preference by offering your customers Bendix-Westinghouse Air Brakes as factory-installed equipment. It's one sure and easy way to add more sales-appeal to your vehicles!



Over 1,500,000 compressors produced over a 25-year span stand behind the TU-FLO 400. Many advanced features guarantee performance no other compressor can equal.

25 YEARS

Bendix-Westinghouse BENDIX-WESTINGHOUSE AIR BRAKES REG. U.S. PAT. OFF. **AIR BRAKES**

BENDIX-WESTINGHOUSE AUTOMOTIVE AIR BRAKE COMPANY • General offices and factory—Elyria, Ohio. Branches—Berkeley, Calif. and Oklahoma City, Okla.

Sensational Piston Performance

UNIFORM CLEARANCE AT ALL TEMPERATURES

STEEL TENSION MEMBER

Anchored only at pin bosses and cast in positive contact with I. D. of piston skirt

Controls Clearance Automatically

ZOLLNER CLEAR-O-MATIC PISTONS

Now, pistons may be fitted to closer clearances than ever before possible. The sensational development of CLEAR-O-MATIC Pistons by Zollner engineers *reduces required clearance to less than .001 with constant uniformity of skirt bearing over the entire temperature range.* Performance results are spectacular. Engines run quietly with no cold slap. Friction is reduced without loss of durability or heat conductivity. There is no danger of scuffing or seizing. The Zollner designed steel tension member incorporates in the aluminum piston the same effective expansion as the ferrous cylinder itself. We urge your immediate test of these sensational advantages for your engine.

Design adaptable to full skirted or slipper-type pistons for gasoline engines for every purpose.

UNIFORM EFFECTIVE SKIRT CLEARANCE AT ALL TEMPERATURES

1. Clearance maintained uniformly at all coolant temperatures from 20° below zero to 200° F.
2. Effective expansion identical with ferrous cylinder.
3. Steel tension member, with same effective expansion as cylinder, maintains uniform skirt clearance through entire temperature range.
4. Normal diametric clearance usually less than .001 with uniform skirt bearing.
5. Durability and conductivity comparable to heavy duty design.

ZOLLNER PISTONS

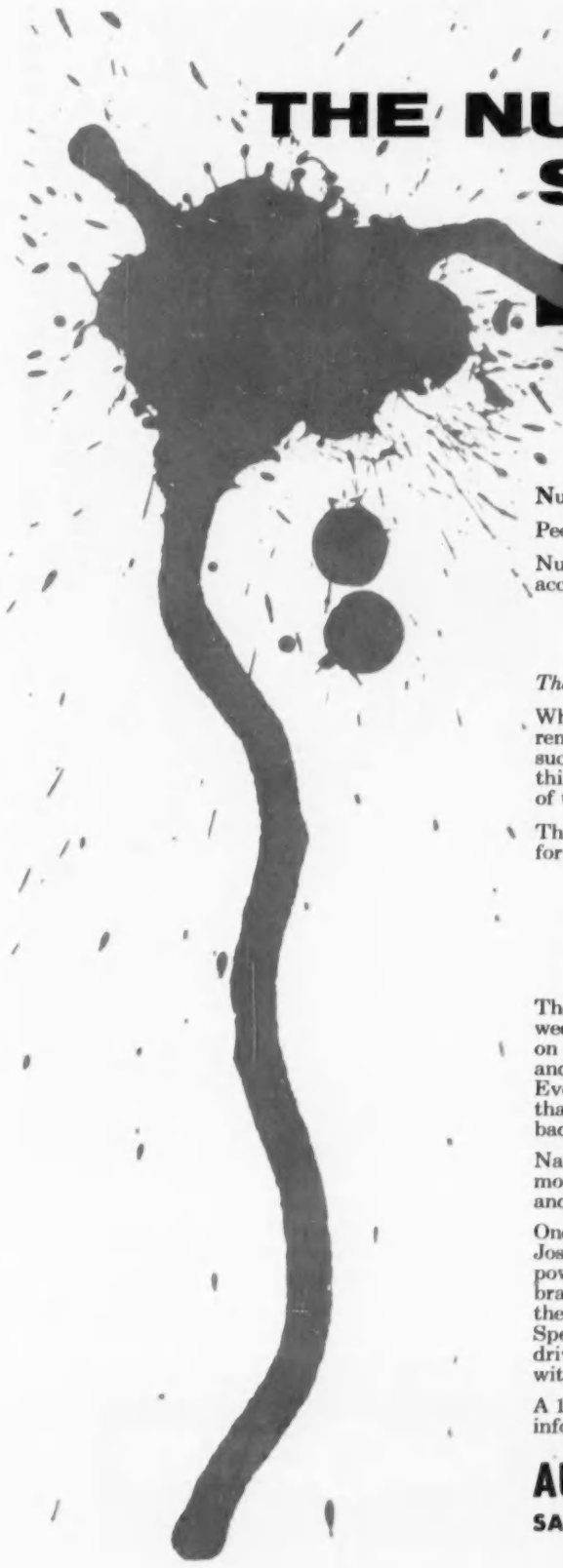
THE ORIGINAL EQUIPMENT PISTONS

ZOLLNER

- ADVANCED ENGINEERING
- PRECISION PRODUCTION

in cooperation with engine builders

ZOLLNER MACHINE WORKS • Fort Wayne, Indiana



THE NUMBER FOR SATURDAY...

134

Numbers aren't emotional or animated.

People are emotional, lovable and very animated.

Number 134 is a statistic. It says 134 people will die in auto accidents this Saturday. It doesn't say

Who Dies or
Where They Die

it only says *will* die.

The certainty of it is frightening.

When you get behind the wheel of your car this Saturday, remember . . . 134 is your enemy. Don't contribute to its success by being inconsiderate on the road. You have everything to gain by being courteous and careful . . . and the lives of the animated innocents to lose by being careless.

There's a number for every day of the week (average figures for automobile fatalities) . . .

134 is the number for Saturday,
115 is the number for Sunday,
70 is the number for Monday, Tuesday and Wednesday,
83 is the number for Thursday, and
95 is the number for Friday.

These numbers are your enemies. Fight them every day of the week. The next time you pull out to pass a car on a curve or on a hill, *think of the number*. Every time you're in a hurry and press heavily on the accelerator . . . *think of the number*. Every time you get behind the wheel . . . there's a number for that day. When you're careless on the road, you're risking a bad trade—your name for a number.

National safety groups, automobile manufacturers and automotive suppliers are all constantly striving to reduce accidents and make driving safer and more pleasant.

One of these suppliers, Auto Specialties Mfg. Co., Inc., of Saint Joseph, Michigan, has developed safer brakes for today's more powerful cars: Auto Specialties Double-Disc Brakes. These brakes, designed on an entirely different principle, have passed the severe braking tests of the leading car factories. Auto Specialties Double-Disc Brakes make driving safer, make drivers surer of their brakes. Their adoption will be in keeping with the automotive industries' aim for safer and safer driving.

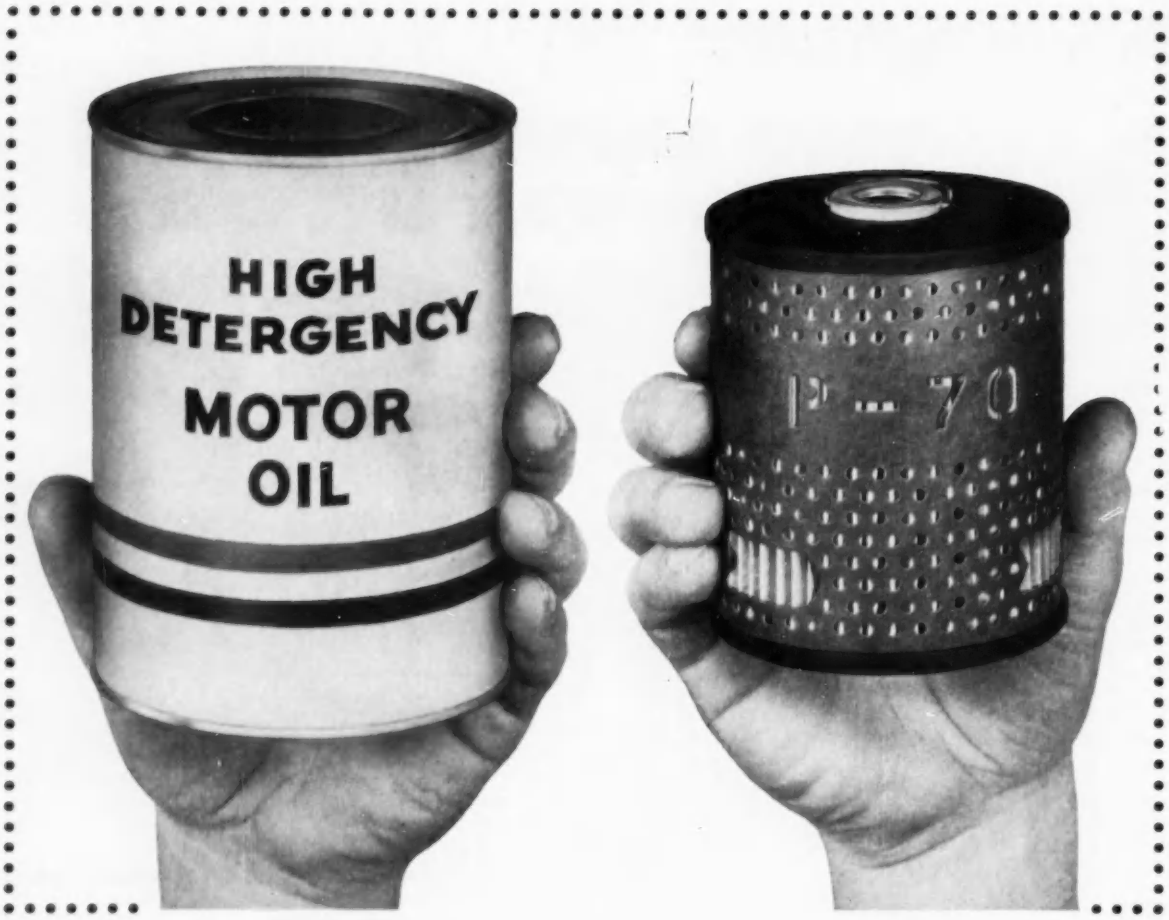
A 16-page, 4-color book, "The Stopping Story," gives detailed information about these brakes. It's free. Write for it to

AUTO SPECIALTIES MFG. CO., INC.

SAINT JOSEPH, MICHIGAN

Plants also at Benton Harbor and Hartford, Michigan
and Windsor, Ontario, Canada

Manufacturing for the automotive and farm machinery industry since 1908



Purolator's "SELECTIVE" FILTRATION leaves additives in

Beneficial additives stay in as HD and heat-resistant lube oils pass through the Micronic* element of a Purolator filter . . . even though the element is straining out sludge, water and impurities as small as one micron (.000039-inch).

It's one of the reasons why original equipment manufacturers in the automotive field use more Purolators than any other make of filter. Besides this "selective" filtration, the accordion-pleated Micronic* element provides ten times the area of older types, making possible:

- ***High flow rates with minimum pressure drop.*** **Purolators themselves can be small . . . yet operate with pumps of standard size.**
- ***Maximum dirt storage capacity . . .*** **for long, efficient service life before replacement.**

*Registered Trade Mark

Micronic elements do not channel. They are waterproof and warp-proof and remain unaffected by engine temperatures. There's a Purolator to fit every vehicle, tractor and other gasoline- or diesel-engine-powered unit in service today. Write for our automotive catalog, No. 2054, to Purolator Products, Inc., Rahway, N. J., Dept. AI-1117.

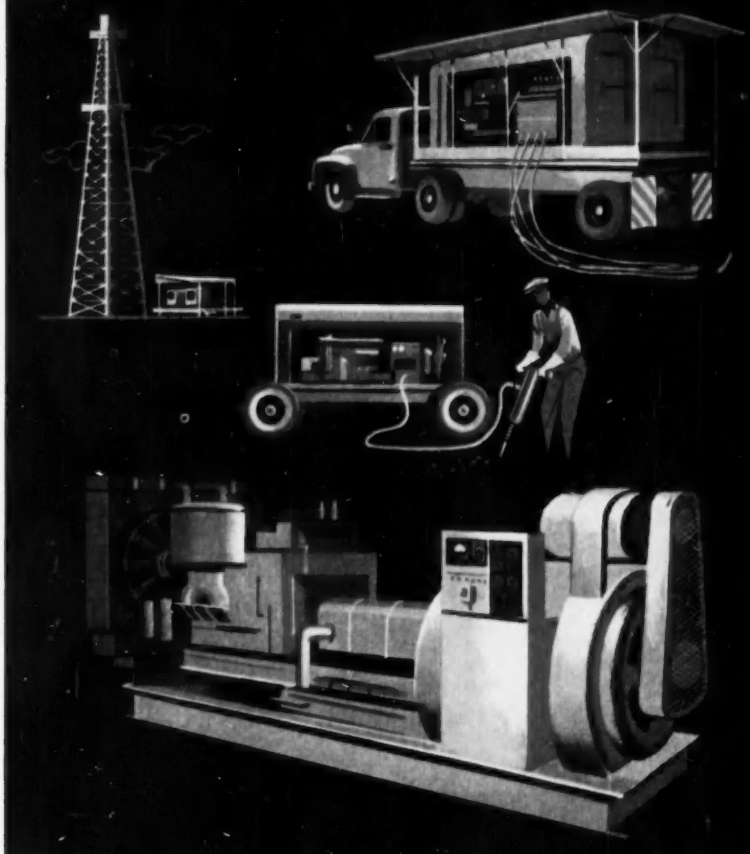
PUROLATOR

"FIRST IN THE FIELD OF FILTERING"

PUROLATOR PRODUCTS, INC., Rahway, New Jersey

BEARINGS...

A Control Factor in Performance!



RESEARCH • DESIGN • METALLURGY • PRECISION MANUFACTURING

Here are industry's work horses . . . dependable diesel engines. They power trucks, tractors, construction equipment. As mobile units they bring light, power and compressed air to the job. As stationary units they light towns and villages. As stand-by units they provide emergency power and light. Their dependability is vital. To help assure this dependability we supply quality bearings for many sizes and types of diesels and are a major supplier to diesel engine builders. **FEDERAL-MOGUL DIVISION,** Federal-Mogul-Bower Bearings, Inc., Detroit 13, Michigan.

FEDERAL-MOGUL
DIVISION

SINCE 1899

NEW Le Tourneau
Sno-Freighter
This huge transporter, 274 ft long, is designed to carry freight and supplies across Arctic wastes, terrain that's impassable for other vehicles. Designed and built by R. G. LeTourneau, Inc., Longview, Texas, the Sno-Freighter is powered by individual electric motors mounted on each wheel. Two 400-hp diesel generator sets furnish the electrical energy. Each unit has two starters and each of these, in turn, uses four 6-volt Globe standard commercial batteries.
Alaska FREIGHT LINES INC.
LET

GLOBE batteries help assure SPINNING STARTS despite Arctic cold, extra-rugged terrain

Here's more assurance for private label marketers that Globe batteries pay off in outstanding performance . . . performance that builds more and more repeat sales. R. G. LeTourneau, Inc. is typical of the many leading equipment manufacturers who rely on Globe batteries because they know fast, sure, dependable starts can mean lives or dollars.

GLOBE-UNION INC., Milwaukee 1, Wis.

For fast service there are 16 Globe Battery Plants—

Atlanta, Ga. • Boston, Mass. Cincinnati, Ohio • Dallas, Texas Emporia, Kansas • Hastings-on-Hudson, N. Y. • Houston, Texas • Los Angeles, Calif. Memphis, Tenn. • Milwaukee, Wis. • Mineral Ridge, Ohio Oregon City, Oregon Philadelphia, Pa. • Reidsville, N. C. • San Jose, Calif. Ajax (Ontario) Canada

IF IT'S PETROLEUM-POWERED ***there's a Globe-built battery . . . right from the start!***

Engineer THE PERFORMANCE with . . .

DSP *Leaf* **SPRINGS**

FIFTY YEARS' experience with all types of leaf spring design, plus rigid manufacturing standards and controls, assure complete spring satisfaction, superior spring performance, and longer spring life.

That's why *the makers of most of America's trucks use DSP Leaf Springs as original equipment.*

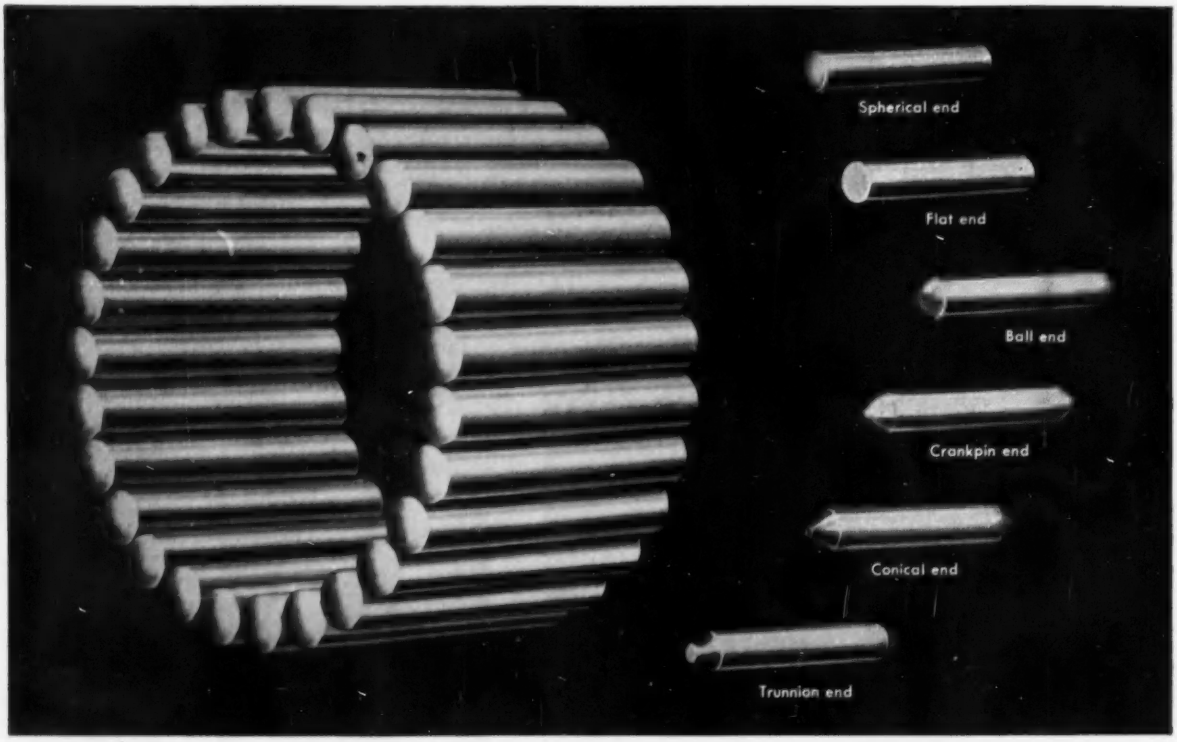
SINCE 1904 — ORIGINAL EQUIPMENT ON CARS, TRUCKS, CABS, BUSES, TRAILERS

Automotive Division

DETROIT STEEL PRODUCTS COMPANY

Also Makers of Fenestra *Building Products*

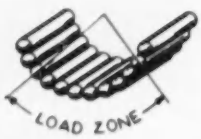
2250 E. Grand Blvd., Detroit 11, Michigan



TORRINGTON Needle Rollers

for the ultimate in load capacity at low cost

High radial capacity in minimum space stems from full complement of small-diameter rollers. Load zone contains maximum number of contact lines.



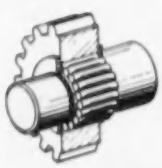
Fine finish contributes to efficient anti-friction performance. Needle Rollers are usually polished to 4-6 rms, but finishes as fine as 1-3 are available on special order.

High carbon chrome steel is carefully hardened, ground and lapped to make each Needle Roller a precision part for long-life performance.

Torrington Needle Rollers provide the lowest cost, highest capacity anti-friction bearings obtainable. They are manufactured in a complete line to meet SAE and AFBMA specifications. Available in the inexpensive spherical end type or in other end shapes, they provide maximum retainment and fillet clearances or greater lip retainment. Needle Roller standards for material, heat treat, tolerance and finish are the highest in the industry.

Good operating results with Needle Rollers require careful design of mating parts furnished by the user. The Engineering Department of The Torrington Company, with broad experience in applications of Needle Rollers, will be glad to give you technical advice on your needs.

Close tolerances on Needle Rollers are assured by stringent quality controls. Standard OD tolerance is .0002" but rollers can be supplied with OD tolerance of .00005." Tolerance on length dimension depends on end formation.



Mounted without races between hardened shaft and hardened housing (RC-60 recommended), Needle Rollers allow largest possible shaft diameters.

THE TORRINGTON COMPANY
Torrington, Conn. · **South Bend 21, Ind.**
District offices and distributors in principal cities of United States and Canada

TORRINGTON *NEEDLE* **BEARINGS**

Needle • Spherical Roller • Tapered Roller • Cylindrical Roller • Ball • Needle Rollers

News you can use about heat-treated castings

If you want the *news* on heat-treated castings, be sure to send for Campbell, Wyant and Cannon's new booklet "One Source!" In it is told the story of CWC's extensive heat-treating facilities . . . how castings made by CWC give greater wear resistance, increased machinability or dimensional stability. "One Source" also contains interesting and important information on all of the subjects listed below.
It's a booklet of value to everyone directly or indirectly concerned with castings.
Get *your* free copy now!

Whatever Your Requirements

GO TO ONE SOURCE

CWC

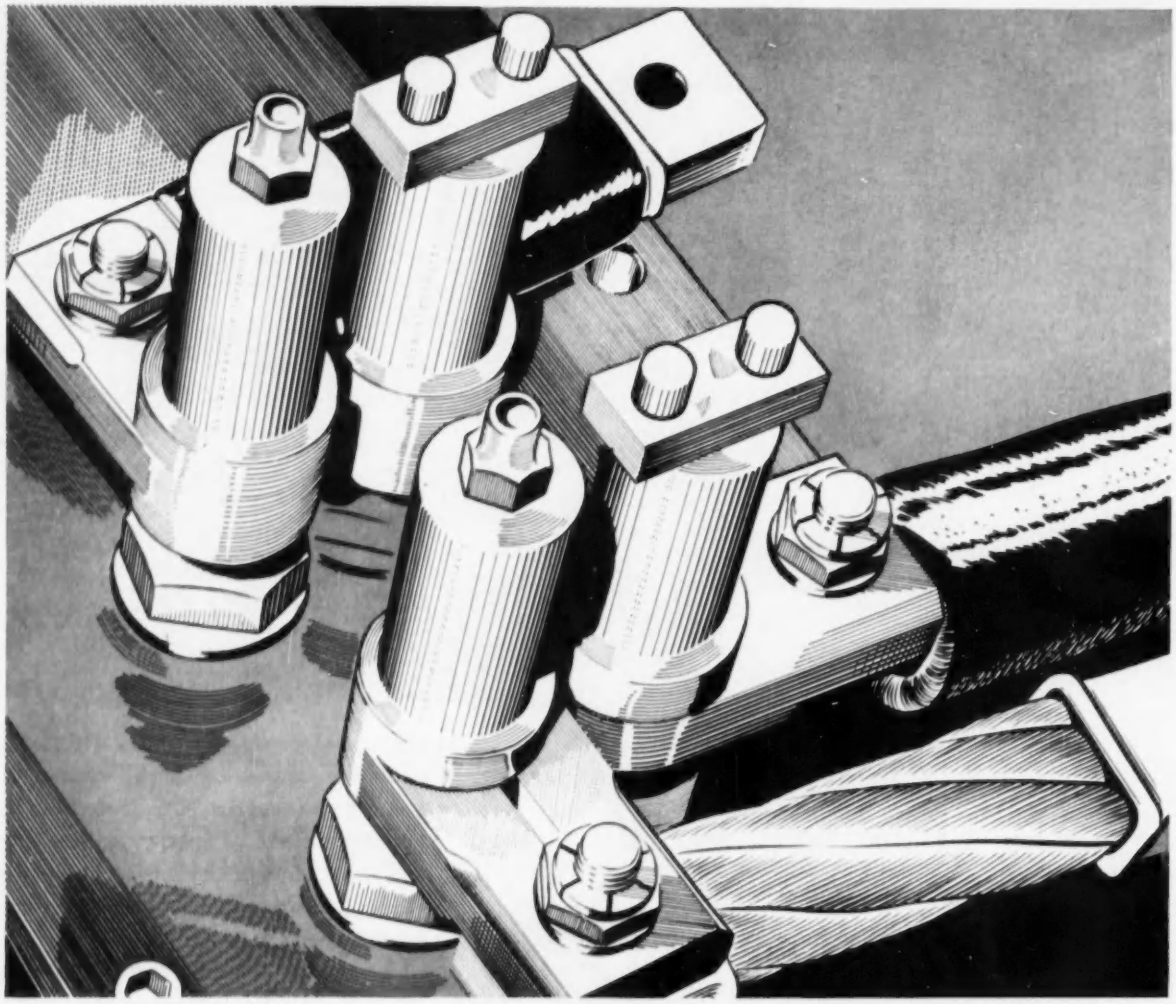
CAMPBELL, WYANT AND CANNON FOUNDRY COMPANY

Muskegon, Michigan

GRAY IRON, ALLOY IRON AND STEEL CASTINGS

- Intricate Castings
- Castings with Special Properties
- General Purpose Castings
- Heat-Treated Castings
- Steel Castings
- Centrifugal Castings
- Castings in Limited Quantities
- Castings in Volume

FLEXLOC AT WORK



DESIGNER OF WELDING DIE uses one-piece, all-metal thin FLEXLOCS as stop nuts on flexible cable assembly. Although the assembly swivels, FLEXLOCS won't work loose.

Nuts that loosen cause trouble. Contact is poor; flow of current erratic; welding faulty—and faulty welding means inferior finished jobs.

Don't take any chance of nuts loosening on vital assemblies. FLEXLOCS are made to stay put. And they are available in a wide range of sizes, types and material. See your authorized industrial distributor for Bulletin 866 and samples. Or write STANDARD PRESSED STEEL CO., Jenkintown 55, Pa.

• • •

Use FLEXLOCs anywhere safely

ON ROUGH BOLTS. They'll smooth out bolt threads without damaging the threads of the nut.

IN TEMPERATURES TO 550°F in plated nuts and even higher in unplated ones. High temperatures do not affect FLEXLOCS. Nuts with non-metallic inserts fail under such conditions.

AS STOP OR LOCK NUTS. After at least 1½ threads of a standard bolt are past the top of the nut, the FLEXLOC stays put.

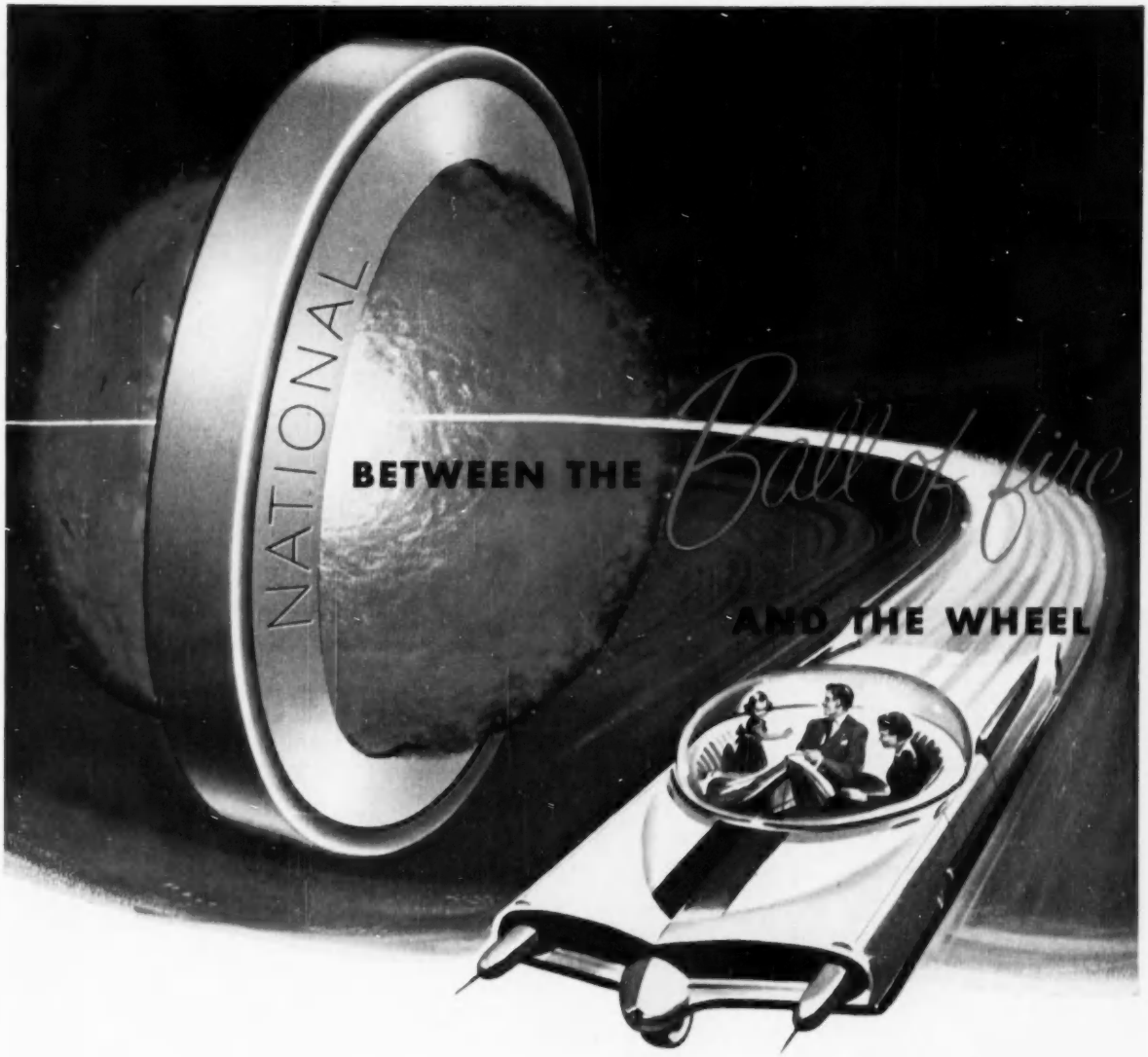
REGARDLESS OF MOISTURE, OIL, DIRT OR GRIT. None of these conditions make any difference to a FLEXLOC, and vibration won't loosen it.

FLEXLOC®

LOCKNUT DIVISION

sps

JENKINTOWN PENNSYLVANIA



Motor cars of tomorrow will be swift and silent beyond belief, powered by the mightiest forces man can employ. Perhaps this power is nuclear, perhaps from a chemical fuel. From either will come the "release explosion"—a swirling "ball of fire"—pure energy to be contained, controlled, delivered to the wheels.

Oil seals will shoulder much of the responsibility. Besides sealing dirt out and lubricant in, seals will serve as air, fuel and even pressure seals. They must withstand shaft speeds to 60,000 rpm at pressures of 60 psi and temperatures to 500°.

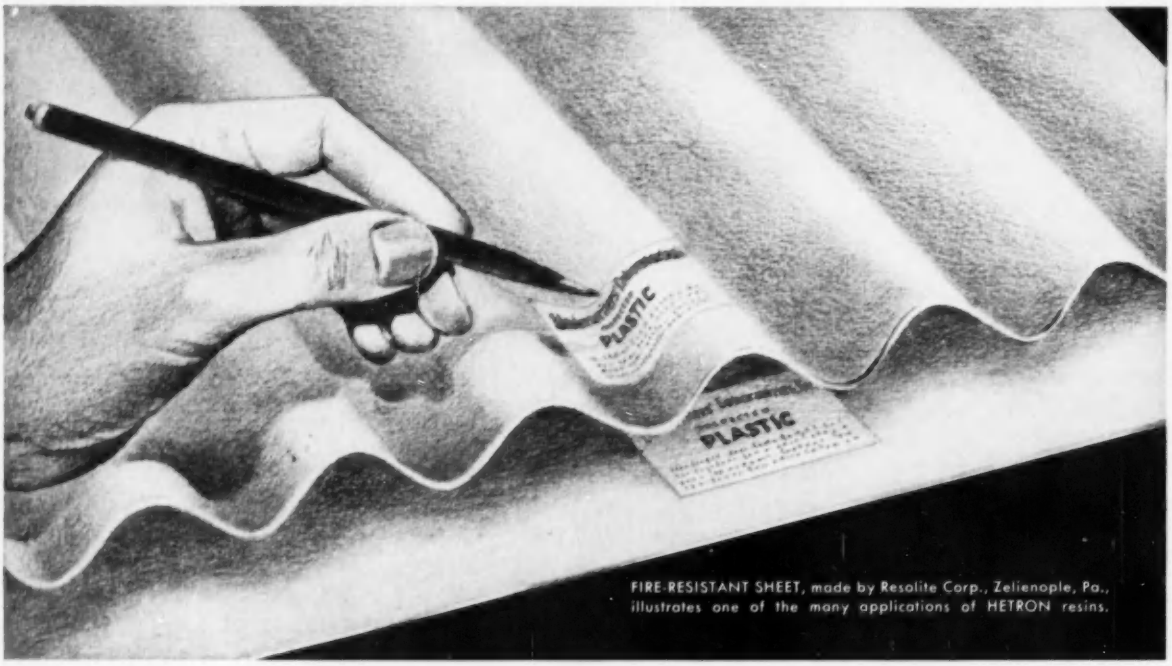
National Motor Bearing's advance engineering program for the future brings about many "years ahead" developments in National products of today.

Sealing Achievement! New NMB Sealed Journal Box Kit* converts standard journal assemblies in freight cars to sealed bath lubrication. This recent development virtually solves the 100-year-old railroad "hot box" problem. It can eventually save railroads over $200 million annually. *Pat. & Pats. Pend.

NATIONAL MOTOR BEARING CO., INC.

General Offices: Redwood City, California. **Sales Offices:** Chicago, Cleveland, Dallas, Detroit, Downey (Los Angeles County), Indianapolis, Milwaukee, Newark, Van Wert, Wichita. **Plants:** Redwood City, Downey and Long Beach, California; Van Wert, Ohio.

NATIONAL OIL SEALS ®



FIRE-RESISTANT SHEET, made by Resolite Corp., Zelienople, Pa., illustrates one of the many applications of HETRON resins.

Yes, you can get a FIRE-RESISTANT POLYESTER

And you can get it without sacrificing strength.

Read these surprising facts about* HETRON(R) *polyester resins

Don't rule out polyester-fibrous glass material on designs calling for a high degree of fire resistance-plus-strength.

You can in all likelihood answer the need with a HETRON-based material.

The inherent fire resistance of HETRON polyester resins make their use possible in many places where glass-reinforced polyester sheet and molded parts have not been permitted.

Light-stabilized HETRON resins now make it possible for you to attain a panel with a high degree of weathering resistance.

Will not support flame

Specific flame resistance is chemically, permanently locked into these resins. HETRON will burn only when a hot flame is applied directly to it. It "snuffs out" as soon as the flame source is removed.

Properly formulated HETRON-based sheets have shown flame spreads as low as 20 by ASTM E84-50T in exploratory tests.

No loss in strength

You do not sacrifice physical properties when you specify HETRON sheet or molded parts for fire resistance. To the contrary, tests show HETRON is *superior in physicals to most non-fire-resistant resins*, both rigid and semi-rigid. In fact, designers and fabricators have specified HETRON for its physical properties alone—with fire resistance as an added bonus.

For more complete information on HETRON, consult your current copy of Sweet's File (Product Design) or Modern Plastics Encyclopedia. For specific test results, samples of HETRON resins, and names of fabricators who can supply you with HETRON sheet and molded parts, write us today.

Comparative Physical Characteristics

HETRON and 10 non-fire-resistant resins

Physical Property		Rigid Resins		Semi-rigid Resins
		HETRON 92	Avg. 10 Others	HETRON 32 A
Flexural Strength, PSIx10³	Room Temp.	38.6	36.4	41.8
	180°F.	25.0	18.6	23.5
Flexural Modulus, PSIx10⁶	Room Temp.	1.88	1.61	1.82
	180°F.	0.90	0.79	0.85
Tensile Strength, PSIx10³		21.7	22.0	21.0
Water Absorption, Pct. by Wt.		0.13	0.29	0.13

SUPERIOR PHYSICALS of HETRON show up in exhaustive tests by independent, impartial laboratories. Panels 0.1" thick, made from HETRON and 10 leading non-fire-resistant resins, contained 35-40% glass mat, 17-20% filler, and the balance resin. Note that HETRON 32A, a semi-rigid resin, is compared with non-fire-resistant *rigid* resins.

1905—Half a Century of Chemicals
From the Salt of the Earth—1955

HOOKER ELECTROCHEMICAL COMPANY

38 FORTY-SEVENTH ST., NIAGARA FALLS, N. Y.

NIAGARA FALLS • TACOMA • MONTAGUE, MICH. • NEW YORK • CHICAGO • LOS ANGELES

HOOKER CHEMICALS

5-178

Engineered by Tinnerman...

NEW SNAP-ON MOTOR CLIP REPLACES 4 PARTS

Cuts Assembly Time and Costs!

If you manufacture or use fractional horsepower motors, this new Tinnerman SPEED CLIP® can lower your parts and assembly costs by eliminating 4-piece screw clamps to hold motors in place.

Made of high-quality spring steel, this SPEED CLIP is quickly snapped into place over the resilient motor-mounting ring, using a simple hand tool. It forms a vibration-proof lock that won't shake free. Assembly time is reduced because of the one-piece construction . . . no loose parts to handle, nothing to tighten. Parts cost and assembly cost are reduced as much as 75%!

These SPEED CLIPS can be provided in sizes to fit any fractional-horsepower motor. They are designed to hold tight even under severest vibration and high starting-torque in any mounting position.

Ask your Tinnerman SPEED NUT sales engineer for more information and arrange for samples to test on your own assembly line.

TINNERMAN PRODUCTS, INC. • Box 6688, Dept. 12, Cleveland 1, Ohio
Canada: Dominion Fasteners, Ltd., Hamilton, Ontario. *Great Britain:* Simmonds Aerocessories, Ltd., Treforest, Wales. *France:* Aerocessoires Simmonds, S. A., 7 rue Henri Barbusse, Levallois (Seine). *Germany:* Hans Sickinger GmbH "MECANO", Lemgo-i-Lippe.

TINNERMAN Speed Nuts®
FASTEST THING IN FASTENINGS®

MAJOR EXPANSION

Creates Promising Positions for

Aeronautical Engineers
Chemists
Chemical Engineers
Mechanical Engineers
Physicists

Stimulating jobs with a future in Combustion Research and Development . . . Applied Research, Development Engineering, Evaluation, Fundamental Engineering and Program Planning.

At General Electric's Aircraft Gas Turbine Division, there is a major permanent expansion, creating permanent positions with career possibilities as big as your own abilities. If you have a BS, MS or PhD, and would like to work for an established industrial leader, get in touch with us. Opportunities for those with or without industrial experience in the areas of Burner Design, Combustion, Fuels, Fluid Flow, Heat Transfer and Thermodynamics.

Please send resume to:

Mr. D. R. Lester
Aircraft Gas Turbine Division
Evandale Plant

GENERAL ELECTRIC

Cincinnati, Ohio

FAST, CLEAN *Panel Marking*

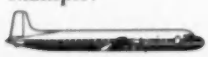
Matthews "222" Nameplate Marking Machine will solve your needs for nameplate production marking.

These compact, safe operating nameplate marking machines can be furnished either pneumatic, hydraulic or hand operated . . . they can't be beat for marking of neat, attractive and perfectly aligned characters or symbols in your blank nameplate panels. Write today for Bulletin B-6.

JAS. H. MATTHEWS & CO.
3962 FORBES ST. PITTSBURGH 13, PA.
BOSTON • CHICAGO • PHILADELPHIA • CLIFTON, N. J.

Engineers!
Join this winning team!

At DOUGLAS you'll be associated with top engineers who have designed the key airplanes and missiles on the American scene today. For example:



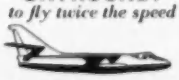
DC-7 "SEVEN SEAS" *America's finest, fastest airliner*

F4D "SKYRAY" *Only carrier plane to hold world's speed record*

C-124 "GLOBEMASTER" *World's largest production transport*

NIKE *Supersonic missile selected to protect our cities*

"SKYROCKET" *First airplane to fly twice the speed of sound*



A3D "SKYWARRIOR" *Largest carrier-based bomber*

A4D "SKYHAWK" *Smallest, lightest atom bomb carrier*

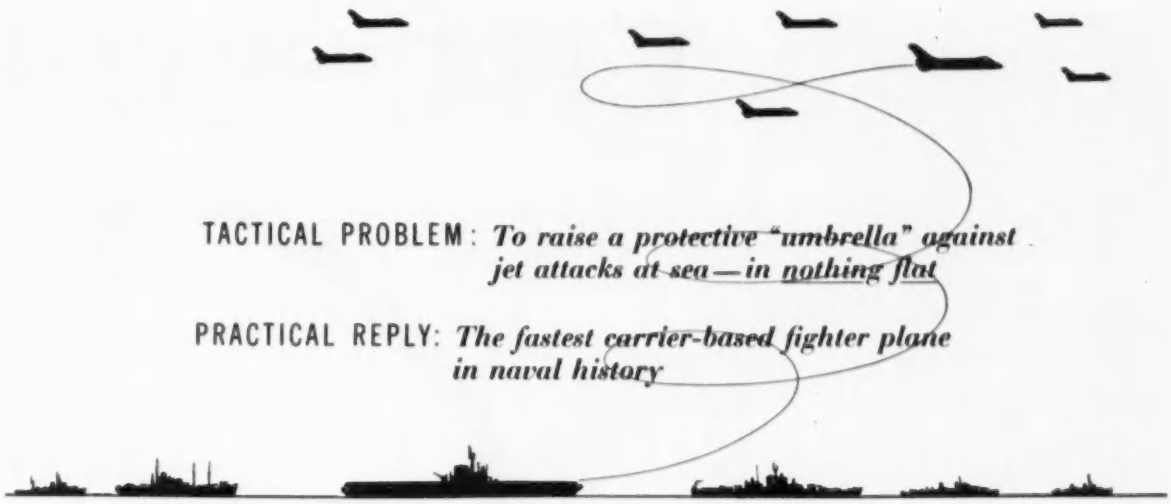
B-66 *Speedy, versatile jet bomber*

With its airplanes bracketing the field from the largest personnel and cargo transports to the smallest combat types, and a broad variety of missiles, Douglas offers the engineer and scientist unequalled job security, and the greatest opportunity for advancement.

For further information relative to employment opportunities at the Santa Monica, El Segundo and Long Beach, California, divisions and the Tulsa, Oklahoma, division, write today to:

DOUGLAS AIRCRAFT COMPANY, Inc.

C. C. LaVene, Employment Mgr.
Engineering General Office
3000 Ocean Park Blvd.
Santa Monica, California



TACTICAL PROBLEM: *To raise a protective "umbrella" against jet attacks at sea—in nothing flat*

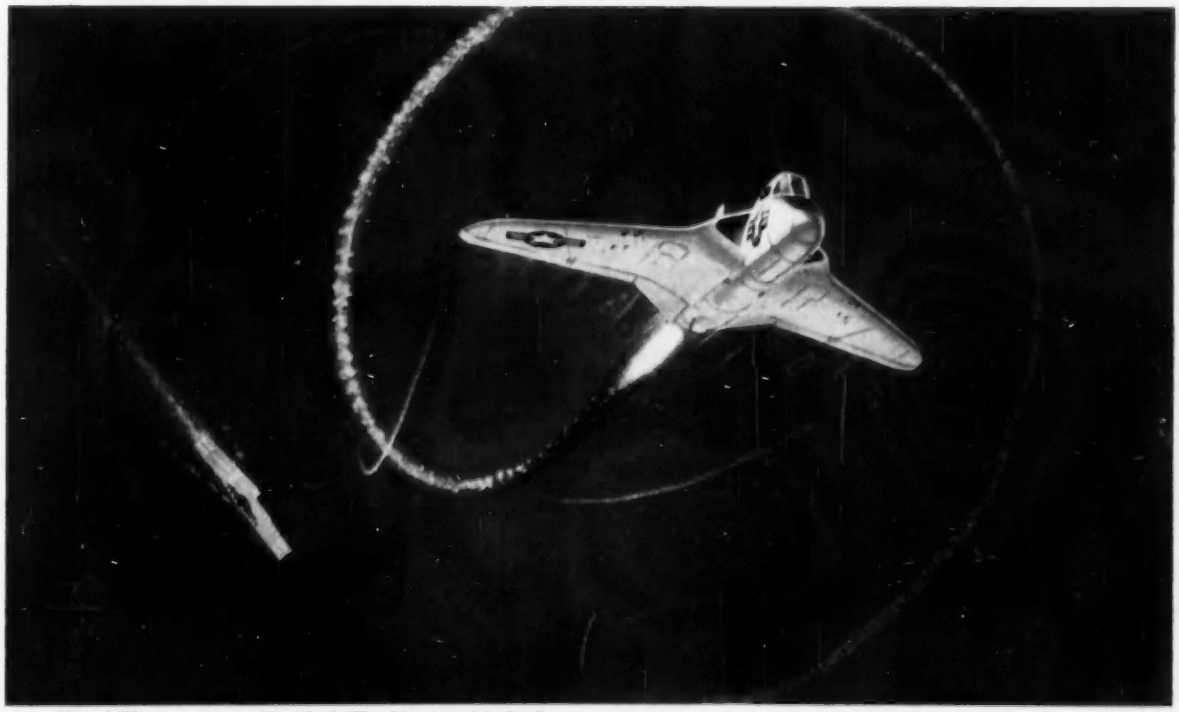
PRACTICAL REPLY: *The fastest carrier-based fighter plane in naval history*

—the DOUGLAS F4D Skyray

Cut loose the power of a Douglas F4D Skyray, and this fast Navy jet climbs from its carrier to operational altitudes in "nothing flat."

Its extremely high rate of climb makes Skyray—holder of the official F.A.I. sea-level speed record—well adapted for assignments of positive interception. Designed for the U. S. Navy, it is powered by a Pratt & Whitney J-57 engine with afterburner and carries an armament of cannons and rockets. Agile as well as fast, Skyray's low landing speeds permit normal operation from any aircraft carrier now in service . . . for unlimited fleet duty.

Skill in design which produced top-performing Skyray is a big reason for Douglas leadership in aviation. And it is the force behind the major trend to simplify aircraft, build more plane per pound, or per defense dollar.



Be a Naval Flier—write to Nav Cad, Washington 25, D. C.

Depend on *DOUGLAS* **First in Aviation**

KLOZURE* OIL SEALS

USED EXCLUSIVELY on RBC's new Sealed "Pitchlign" Roller Bearings

Springless KLOZURE Oil Seal Model 71-A, with synthetic rubber sealing member securely bonded to and integral with a metal case.

In designing their new sealed "Pitchlign" roller bearing, the Roller Bearing Company of America (W. Trenton, N. J.) needed a proven, dependable oil seal of narrow cross section.

RBC engineers selected springless KLOZURE Model 71-A. They found this superior seal was specifically designed for limited space applications. In addition, Model 71-A had proved on thousands of applications that it would keep out dust and retain the lubricant for the *life of the bearing.*

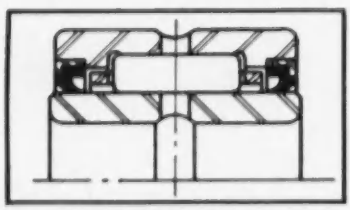
Let us show you how Garlock KLOZURES can solve your sealing problems. There's a proven KLOZURE model for every bearing application.

For full information contact the Garlock office nearest you or write for KLOZURE Catalog No. 10.

*Registered Trademark

THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK

Sales Offices and Warehouses: Baltimore, Birmingham, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Denver, Detroit, Houston, Los Angeles, New Orleans, New York City, Palmyra (N. Y.), Philadelphia, Pittsburgh, Portland (Oregon), Salt Lake City, San Francisco, St. Louis, Seattle, Spokane, Tulsa.
In Canada: The Garlock Packing Company of Canada Ltd., Toronto, Ont.



Two springless KLOZURES, lips turned in, on "Pitchlign" bearing provide life-time retention of the lubricant.

RBC's new sealed "Pitchlign" roller bearing with two built-in springless KLOZURES.

GARLOCK

PACKINGS, GASKETS, OIL SEALS
MECHANICAL SEALS
RUBBER EXPANSION JOINTS

GM
GENERAL MOTORS

ANNOUNCES THE WORLD'S FINEST STEERING SYSTEM!

NEW Safety Power Steering insures more effective demonstrations—easier sales—happier customers—more profit per deal—more repeat business!

new

Safety POWER STEERING

WITH 3 MAJOR IMPROVEMENTS FOR 1956!

NEW

"FROM THE GROUND UP"
A completely redesigned, simplified In-Line system with only 49 parts and basic improvements in steering geometry beginning right at the front wheels. Every part has been specifically engineered for *power* steering.

AUTOMATICALLY LIMITS MANUAL EFFORT WHILE PARKING. New *reaction-limiting valve* cuts in whenever turning resistance reaches predetermined point; increases power assistance to lower manual effort.

AUTOMATICALLY HELPS HOLD CAR "ON COURSE"
—*Precision pre-load* built into ball-nut-and-worm assembly helps keep wheels centered straight ahead.

Write Dept. 35E for FREE facts booklet on NEW Safety Power Steering System

1 TWICE-AS-EASY PARKING!
Thanks to a revolutionary new valve design, maneuvering with the NEW In-line 1956 *Safety* Power Steering System requires only *half as much effort* as previous models. Parking's just a gesture!

2 GREATER ROAD STABILITY!
Safety Power Steering has always had the finest "road feel" of any power steering. The NEW 1956 system gives an even greater sense of security. *It helps you keep your car steadily "on course"!*

3 RELAXING NEW RESPONSE!
The steering wheel responds more easily than ever before with the NEW *Safety* Power Steering System. This means less mental and physical fatigue, more relaxation in traffic and on the highway!

STANDARD EQUIPMENT on all 1956 Cadillacs, Buick Roadmasters and Supers, and Oldsmobile Ninety-Eights—optional on all other 1956 Buicks, Oldsmobiles and Pontiacs. (*Linkage type available on all 1956 Chevrolets.*)

Saginaw
STEERING GEAR DIVISION
GENERAL MOTORS CORPORATION, SAGINAW, MICH.

XII

This is the twelfth of a series of advertisements dealing with basic facts about alloy steels. Though much of the information is elementary, we believe it will be of interest to many in this field, including men of broad experience who may find it useful to review fundamentals from time to time.

Vanadium Alloy Steels and Their Uses

Though the beneficial effects of vanadium in alloy steels have been known for many years, the ore was at one time a comparative rarity. Vanadium is still rather expensive because of the care required in processing the ore; however, there are now ample supplies for present-day applications.

Vanadium is a highly valuable alloying agent. It is an extremely powerful deoxidizer, though seldom used primarily for that purpose. Vanadium also tends to form stable carbides in steel—carbides that do not go readily into solution when heated above the critical temperature for quenching. The grain-growth-inhibiting effect of vanadium promotes a fine-grained structure over a fairly broad quenching range, thus imparting strength and toughness to the heat-treated steel. Moreover, the carbides are not prone to agglomerate during the tempering operation.

Vanadium is used in constructional steels, not only to refine the grain, but to improve the mechanical-property balance. Generally speaking, the amount of vanadium in constructional steels ranges from approximately 0.03 to 0.25 pct, though larger quantities are required in tool steels and special analyses. A list of products containing vanadium would include certain types of spring steels, plates, gears, high-temperature steels; forged axles, shafts, and turbine rotors; and other items requiring impact- and fatigue-resistance.

You are invited to consult with our staff whenever you need information about vanadium steels. Bethlehem metallurgists will gladly advise you regarding analyses, heat-treating, machining, and anticipated results. Please remember that the services of these technicians are yours for the asking, and that no obligation is implied.

And may we point out, too, that Bethlehem makes all AISI standard alloy steels, as well as special-analysis steels and the full range of carbon grades. Call upon us for your alloy steel requirements; now and always, we will endeavor to meet your needs promptly.

If you would like to have a reprint of this advertisement, or of the entire series from I through XII, please write to us, addressing your request to Publications Dept., Bethlehem Steel Company, Bethlehem, Pa.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

Lockheed diversification in action...

Below: engineers and scientists work on some of the 46 major projects in progress at Lockheed

Operations Research discussion on continental defense

Operations Research openings

Electronics Specialists
Fire Control and Guidance Specialists
Aerodynamics Engineers
Physicists

Fatigue test on Super Constellation skin

Structural Engineering openings

Research Specialists
Structures Engineers
Stress Analysts
Weight Engineers

Hot-air cyclic de-icing test on radar search plane

Thermodynamics openings

Research Specialists
Thermodynamics Engineers
Thermodynamicists

Design study on hydraulic requirements of new transport

Design openings

Design positions are open at all levels in controls, electrical, hydraulics, mechanical, power plant and structures fields.

IBM 701 applied to jet transport flutter problem

Math. Analysis openings

Math. Engineers
Math. Specialists
Math. Analysts

Antenna pattern study on radar search planes

Electronics openings

Electronics Research Engineers
Airborne Antenna Designers
Research Specialists

In-flight test on air speed performance

Flight Test Engineering openings

Flight Test Engineers
Flight Test Analysts
Instrumentation Engineers
Electrical Research Engineers

Aerodynamic meeting on high-speed fighter

Aerodynamics openings

Aerodynamics Engineers
Aerodynamicists
Dynamics Engineers
Wind Tunnel Test Engineers

Why Lockheed offers Engineers better careers

There are three main reasons:

1. More opportunity for promotion
because there are more supervisory positions to be filled with 46 major projects underway, including 13 models of aircraft on assembly lines.

2. More career security
because Lockheed activities cover virtually the entire spectrum of aeronautical endeavor.

3. Life in Southern California
Scenic beauty, unmatched climate, wide recreational opportunities enhance life in the San Fernando Valley.

To Engineers who lack aircraft experience

Aircraft experience is not necessary to join Lockheed. It's your engineering training and experience that count. Lockheed trains you for aircraft engineering – at full pay.

Coupon below is for your convenience in requesting application form and more information on how Lockheed's expanding program can advance your career.

E. W. Des Lauriers, Dept. C-16-11

Lockheed AIRCRAFT CORPORATION
CALIFORNIA DIVISION • BURBANK
California

Please send me a brochure describing life and work at Lockheed and an application form.

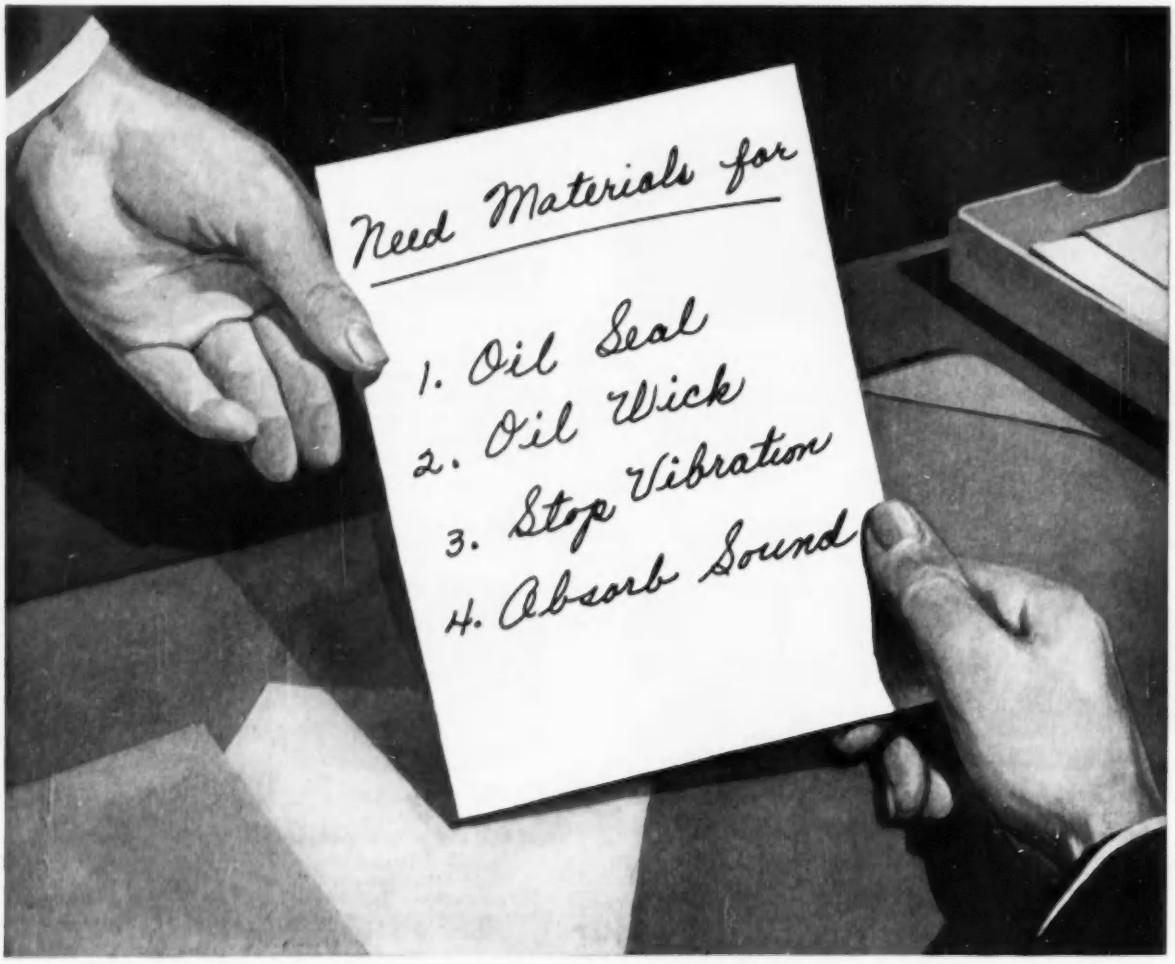
Name

Field of Engineering

Street Address

Phone

City and State



for all four
Your best answer is

Felt

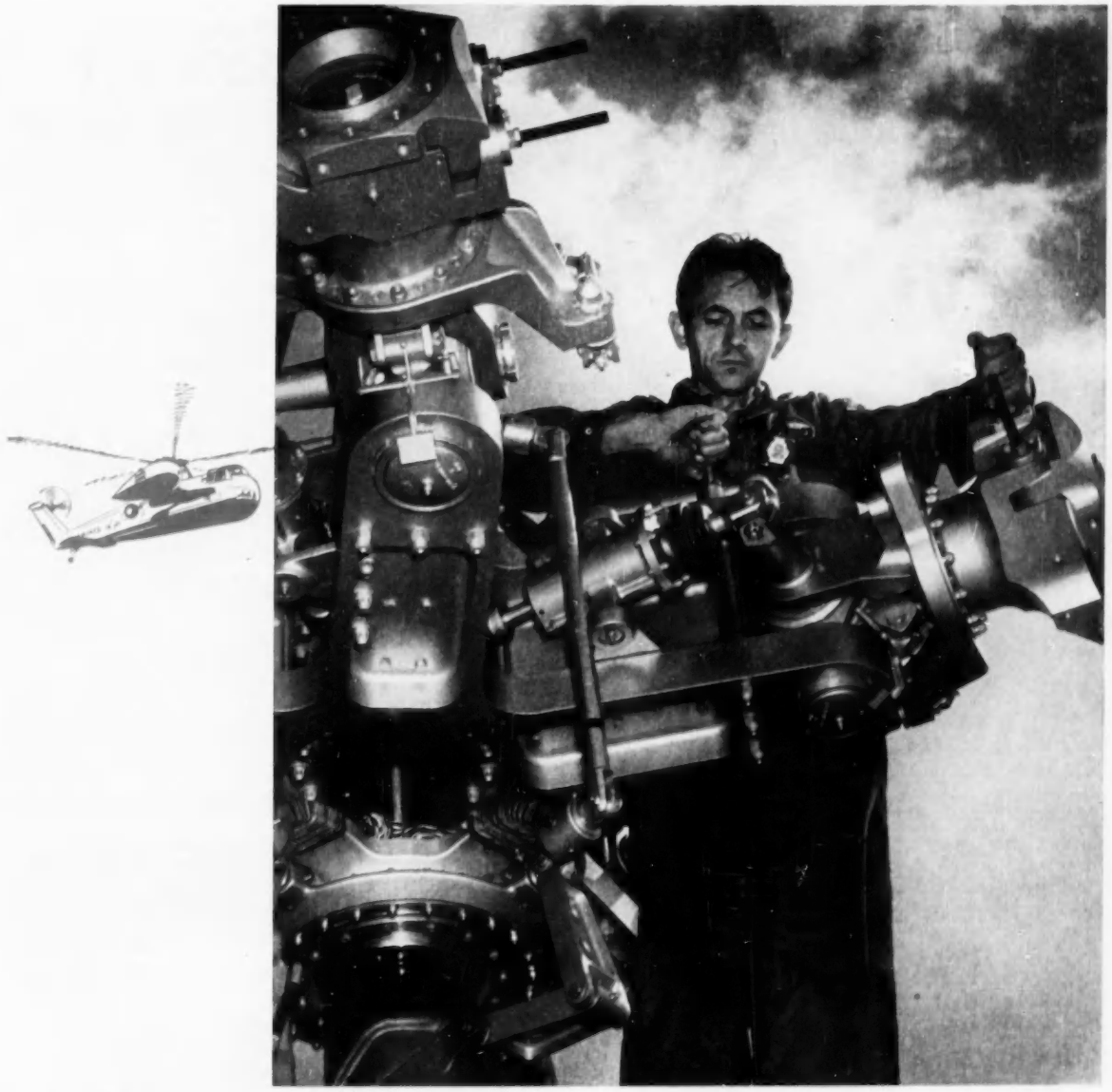
Western Felts can be made as soft as virgin wool or as hard as bone—or any desired specifications in between. But always, their live fibers hold their shape. They never ravel or fray . . . resist wear, age, and weather.

For over 56 years Western Felt has manufactured and cut specification felts for all industries. Whatever your problem, our experience can be helpful. Let our engineers investigate that possibility for you.

WESTERN
4021-4139 Ogden Ave
Chicago 23, Illinois
Branches in all Principal Cities

Felt **WORKS**

MANUFACTURERS AND CUTTERS OF WOOL FELT



Sikorsky rotor heads stress ESNA

A 16-year fastener field test

How many different stresses are exerted on this rotor head as it controls the cyclic and collective pitch of the five main blades of the Sikorsky S56 designed to transport 26 fully equipped troops? Since it also transforms engine power into forward motion or vertical flight, the stresses add up to an interesting but complicated problem in dynamics. Notice that Sikorsky has solved the fastening problems related to this rotor head design with dozens of standard hexagon and double hexagon Elastic Stop nuts.

They are self-locking, maintain precision adjustments and assure fastener security under the vibration and stress loads normal to helicopter flight.

Sikorsky Aircraft Company had been using Elastic Stop nuts for over a decade before it began developing rotary wing aircraft in 1939. They have been a steady ESNA customer for 27 years and Elastic Stop nuts have been a standard fastener on every new Sikorsky design.

If you recognize the practical value of almost three decades of "flight tested" experience on all types of air frames and engines . . . you'll rely on Elastic Stop® nuts.

ESNA

ELASTIC STOP NUT CORPORATION OF AMERICA

Department N83-1175 · 2330 Vauxhall Road · Union, New Jersey

This 8 Page Booklet will help you get *Better Quality Control!*

It tells how a number of precision manufacturers, including the leading automobile companies, use Lake Shore base and surface plates for dynamometers and other test instruments, for layout, mock-up, and inspection. Eight pages, well illustrated, contain application photos, engineers' dimensional drawings, surface tolerances, tensile strength, analysis, and other specifications.

Lake Shore plates are made of fine grained flaw-free "Lakenite" iron . . . and are available machined, ground or hand scraped. Standard plates are available in a wide range of sizes; and for special requirements, Lake Shore engineers can design special plates to any size.

Send for your free *copy of this helpful booklet.*

LAKE SHORE, Inc.

Lake Shore Engineering Division

IRON MOUNTAIN 8, MICHIGAN

Please send me a free copy of the new eight page illustrated Lake Shore base plate booklet.

Name_____

Title_____

Company_____

Address_____

City_____

Champion

BY MILSCO

NO. F850

BODY-FORM POSTURE DESIGN FOR IMPROVED WORK-POWER

Designed to improve the read-ability and comfort-factor of many types of mobile equipment. Full cushion roomy seat equipped with permanently aligned synchronized "no-sag" springs and foam rubber topper. Contour back rest deeply cushioned with foam rubber and jute felt. Snap-on detachable arm rests add to operating comfort and seat versatility. Ball type seat adjuster with finger-lift handle. Get the complete facts on this popular Milsco "Champion" . . . one of the finest cushion seating products of our more than quarter century experience.

SOLD ONLY TO MANUFACTURERS OF ORIGINAL EQUIPMENT

Milsco MILWAUKEE

DETACHABLE *Snap-On Arm Rest*
HALF-INCH BALL TYPE SEAT ADJUSTER
NO-SAG SPRINGS WITH FOAM RUBBER
SOLID TUBULAR STEEL FRAME

MILSCO MANUFACTURING COMPANY, 2758 N. 33RD STREET, MILWAUKEE 45, WIS.

You build the right cab for your truck . . .

here's how to get the **right** heater, too!

Your heater, like the cab for your truck, should be designed and built to meet your own truck requirements.

The heater Evans engineers design and custom-build for you will meet *all* your truck requirements. It will fit *right* – for quick, easy installation. It will deliver all the BTU's needed for maximum driver safety and comfort—under *any* weather conditions.

And because Evans teams a special heavy-duty, continuous-service motor, exclusive one-piece die-cast alloy fan, and sturdy fin and tube type core, the owner gets longer heater service with less maintenance.

Every Evans heater also carries a parts "repair or replace" warranty good for one year or 50,000 miles, whichever occurs first.

Phone or write to have an Evans engineering consultant call on you at no charge. And write now for your free copy of the new Evans Heater Catalog to: Evans Products Company, Dept. Z-11 Plymouth, Michigan.

REGIONAL REPRESENTATIVES: **Cleveland, Frank A. Chase • Chicago, R. A. Lennox Co., Inc. Detroit, Chas. F. Murray Sales Co. • Allentown, Pa., P. R. Weidner**

EVANS
HEATERS AND VENTILATORS

Complete truck and bus systems . . . built right for the job!

SAE

offers the new ....

BLAST CLEANING MANUAL

SP-124

- A BRAND NEW SAE MANUAL—the Blast Cleaning Manual—SP-124, newly listed with our publications, is priced at $2.00 per copy to SAE members and $4.00 per copy to nonmembers; quantity prices upon request.

- A "HOW-TO-USE-IT" BOOK—SAE Blast Cleaning Manual, the work of Division XX—Shot Peening, Iron & Steel Technical Committee, instructs engineers, designers, and shop men in blast cleaning "know how."

- A FIRST COMPLETE STORY—the Manual fully discusses blasting abrasives, blast cleaning machines, production procedures and process specifications; includes 36 illustrations and 3 tables.

ORDER BLANK

Society of Automotive Engineers
29 West 39th Street
New York, New York

Add 3% city sales tax for deliveries in N. Y. C.

Please send me .... copies of SP-124 (Check) (Cash) (Coupons)

Name _____

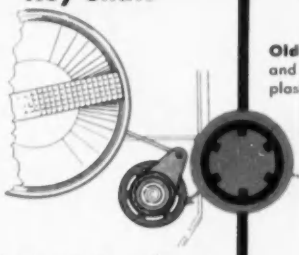
Company Name _____

Company Address _____

5 Waldes Truarc Rings simplify assembly, eliminate parts, bring big over-all savings to new design low-cost camera

Anscoflex II Camera

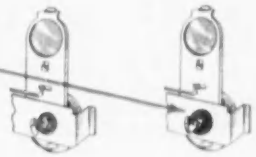
Key Shaft



Parts originally designed for self-locking Truarc ring (series 5105). Some cameras in the past had brass cup staked to the body. At times staking operation cracked the plastic, resulting in loss of expensive part.

Portrait and Filter Lens Knob Assemblies

Old way: Knob with plastic shaft used washer and heat forming operation that flattened the plastic pin and locked the pivot in position.

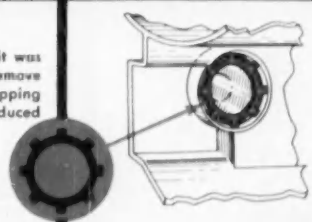


Truarc way: Molded plastic knob with pin is easily and quickly held by a Truarc self-locking ring (series 5105). No groove is necessary. Washer is eliminated and it is possible to remove ring if necessary without damage to knob.

Winding Knob

Old way: With screw and washer design, it was necessary to disassemble entire camera to remove screw which secured winding knob. Self-tapping screw sometimes failed to secure knob, produced excessive end play.

Truarc way: Truarc "E" ring (series 5133) allows removal of winding knob without major disassembly of camera, reducing repair time. Use of stacked rings and Truarc applicator saved $10.40 per M on labor. Material saving: $2.29 per M.

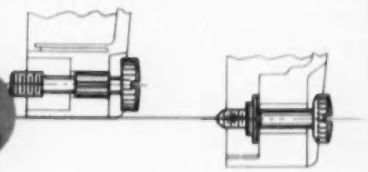


Rear Lens

Parts originally designed for self-locking Truarc ring (series 5005). Some cameras in the past had glass element secured by heat forming tabs from plastic body. Loose or chipped elements resulted in loss of both parts.

Flash-Gun Case Assembly

Old way: In the original design a sleeve was wrapped around neck of screw and pressed into hole of plastic cover. Close working areas made assembly difficult and required extra operation to lock ring into place.



Truarc way: Series 5133 E-Ring snaps onto unthreaded shank of screw quickly, needs no special groove. Labor saving $7.06/M.

Ansco, Binghamton, N. Y., uses the latest technical advances in construction to produce an economical, easy-to-use reflex camera. 5 Waldes Truarc Rings are used in this new design to save material and labor costs, eliminate parts, simplify assembly and reduce rejects.

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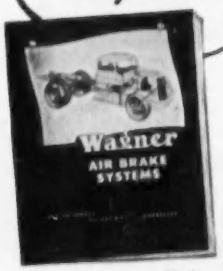

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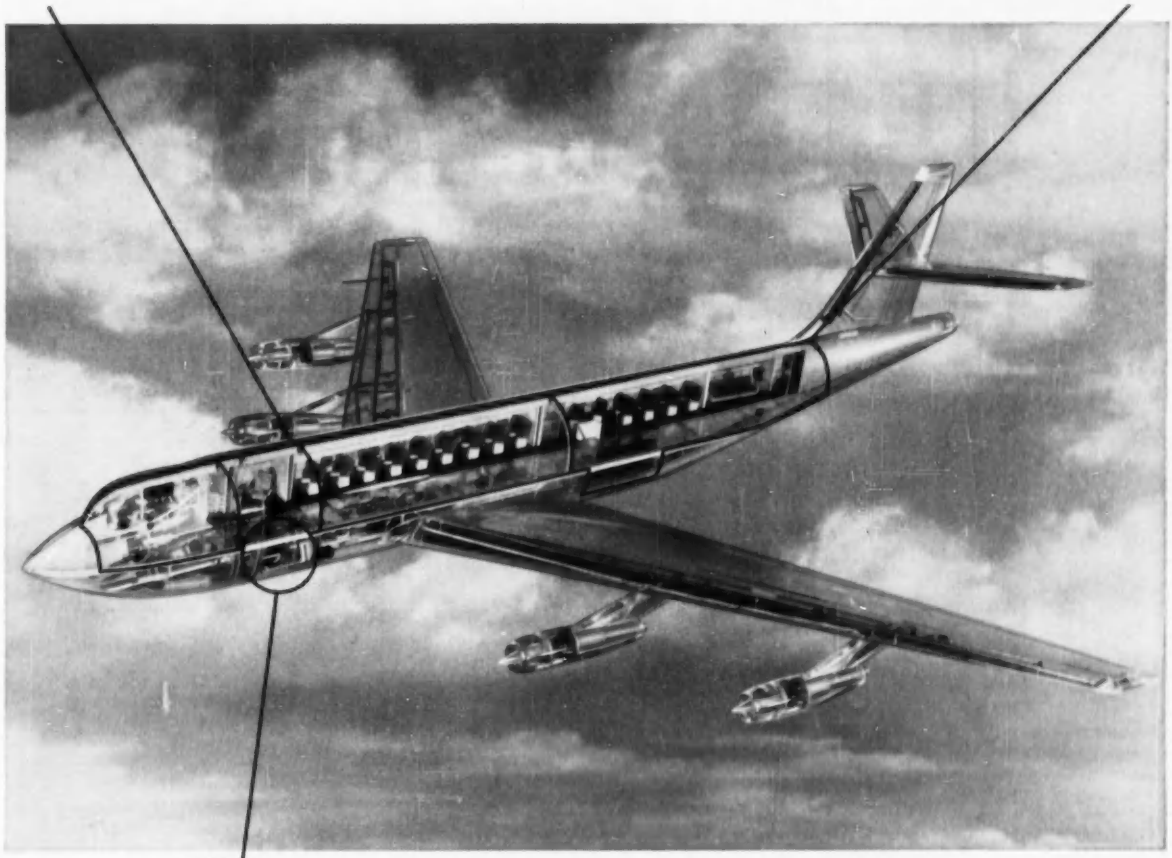

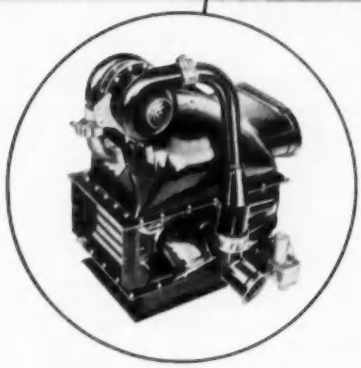

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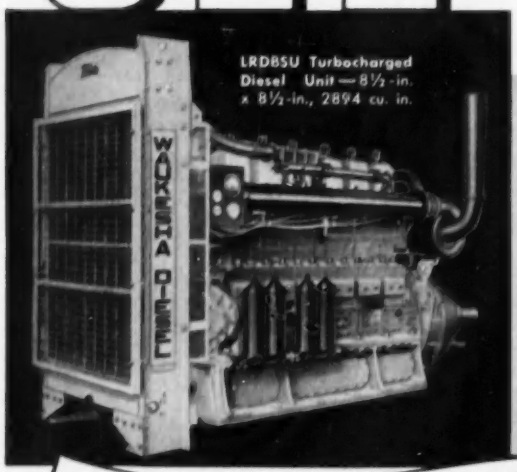

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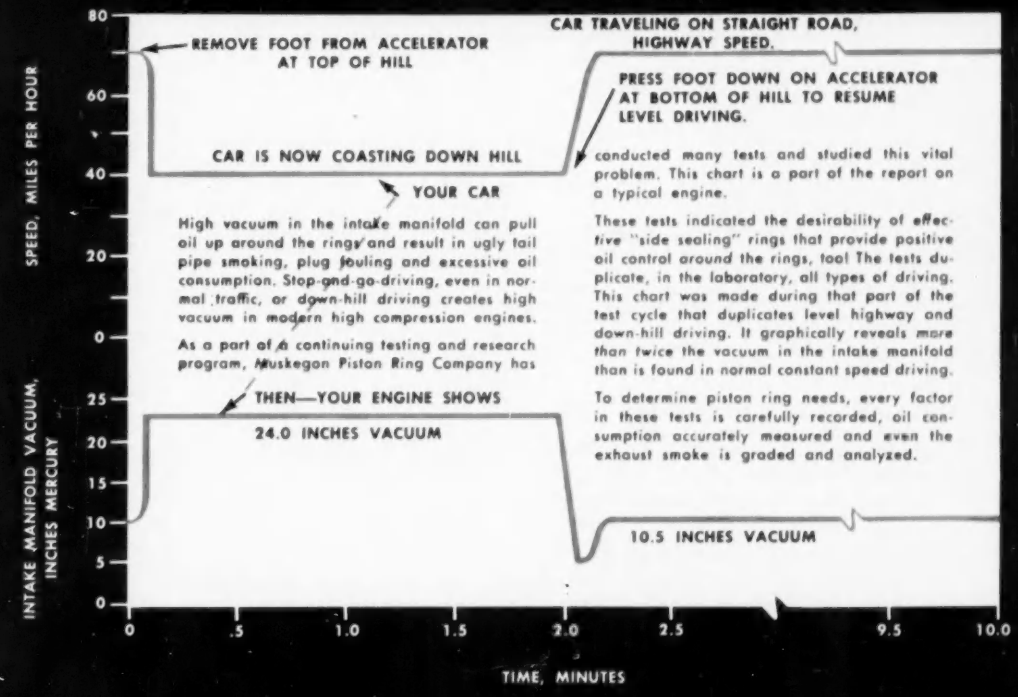
High Vacuum Creates Oil Control Problems...



High vacuum in the intake manifold can pull oil up around the rings and result in ugly tail pipe smoking, plug fouling and excessive oil consumption. Stop-and-go-driving, even in normal traffic, or down-hill driving creates high vacuum in modern high compression engines.

As a part of a continuing testing and research program, Muskegon Piston Ring Company has conducted many tests and studied this vital problem. This chart is a part of the report on a typical engine.

These tests indicated the desirability of effective "side sealing" rings that provide positive oil control around the rings, too! The tests duplicate, in the laboratory, all types of driving. This chart was made during that part of the test cycle that duplicates level highway and down-hill driving. It graphically reveals more than twice the vacuum in the intake manifold than is found in normal constant speed driving.

To determine piston ring needs, every factor in these tests is carefully recorded, oil consumption accurately measured and even the exhaust smoke is graded and analyzed.

Muskegon's New "Side-Sealing" Piston Rings Solve 'Em!

Using these extensive laboratory tests as an engineering basis, Muskegon has designed three new "Unitized" oil control rings that cover the problems created by high intake manifold vacuum.

These new "side sealing" rings incorporate a wedge action that effectively seals the ring grooves to prevent oil flow around the rings. They also incorporate the features that have made Muskegon rings synonomous with performance and long life. They're chrome plated and lapped to give faster break-in and reduced wear. They're "Unitized" to provide faster handling and error-proof installation. A special adhesive is used to bind the ring components together... the adhesive dissolves during run-in, leaving the pieces free to form a perfect seal.

These new "side sealing" piston rings are available now. Write today for complete details. Give us your ring requirements and specifications and we will furnish quotations and samples for your examination. *Muskegon Piston Ring Co., Muskegon, Michigan.*

Patent Number 2,140,710

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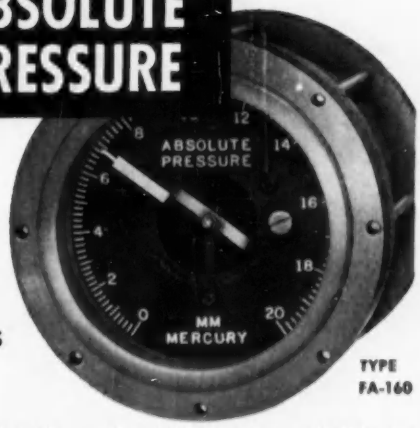

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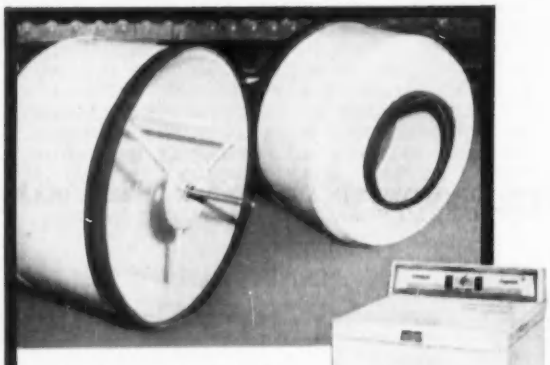

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American supplies Whirlpool Corporation, St. Joseph, Mich., with felt for its dryers. The Imperial model shown here uses plain felt as a seal at the loading port. At the exhaust, where the air is hot and full of moisture, the felt is blended with Hycar, which provides moisture resistance. The dryer drum rotates at 45 r.p.m., and the felt seals effectively keep heated air and moisture out of the cabinet, and heated air in the drum at somewhat less than atmospheric pressure during operation. The seals are supplied as sewn rings, ready for fast, economical installation.

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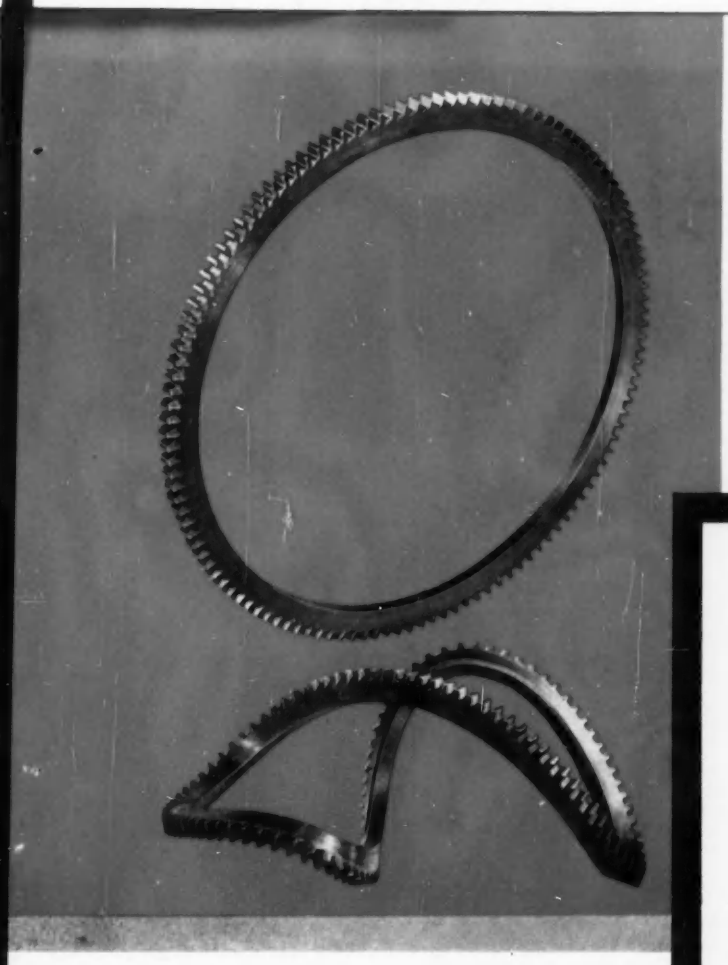
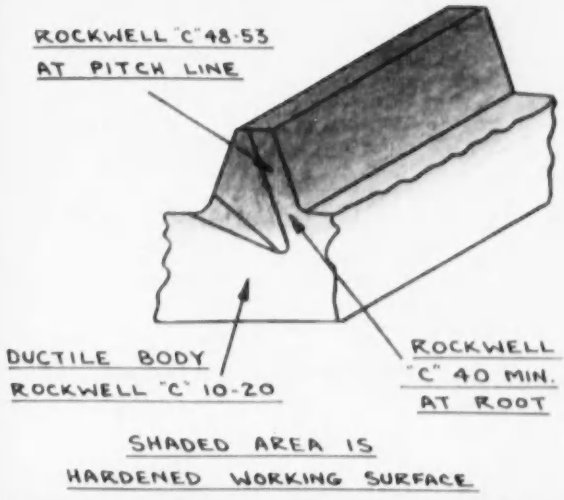


THIN! TOUGH! ...and "tender-hearted"



THE MANUFACTURE of flywheel ring gears poses special problems. Sectional thickness is usually less than three-quarters of an inch. To withstand the impact force of the starter pinion, the gear teeth must be hard. But the gear body itself should be unhardened so that it will conform tightly to the flywheel, and "give" under the stress that might snap a brittle gear.

Note how DOUBLE DIAMONDS are made to be thin, tough, "tender-hearted." The above photo of a gear twisted into a pretzel shape graphically demonstrates ductility. The sketch at right shows three important areas: the wide and deep hardness pattern, the generous area of transition, and the ductile body. These extremes are achieved in DOUBLE DIAMOND Flywheel Ring Gears by controlled selective heat treatment—all essential to flywheel ring gears that provide the best possible performance.

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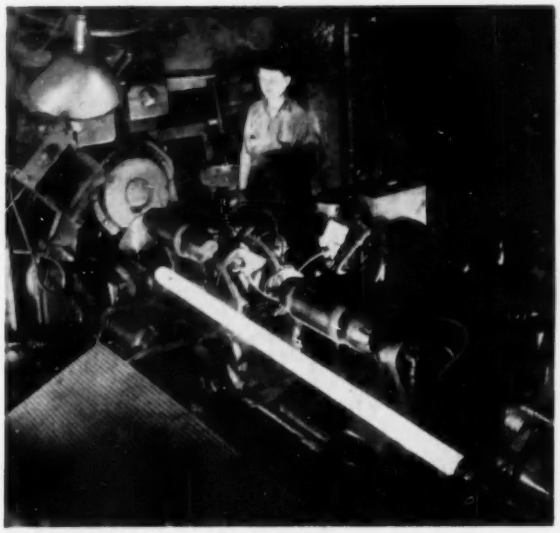
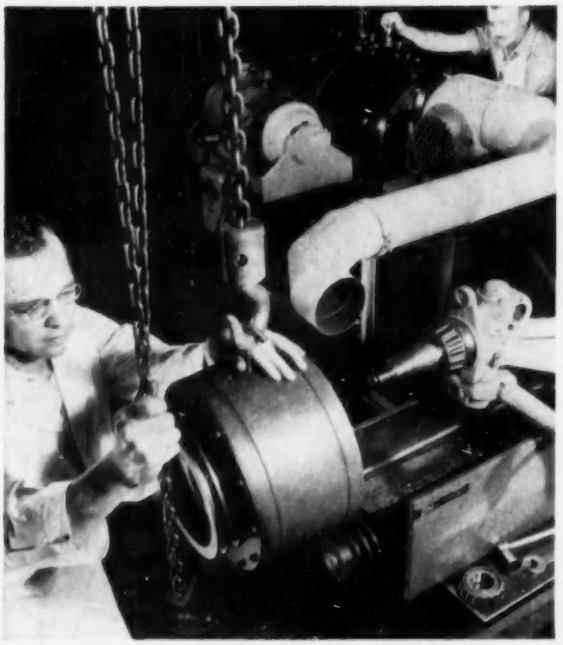
WE NEED THE WORLD'S BEST bearing steel so we make our own. We're America's only bearing manufacturer that does. And we make it nickel-rich for superior toughness. Shown above is a piercing mill that makes seamless tubing for Timken bearing cones and cups. This mill uses the Timken-Company-developed "elongator" process that gives closer size tolerances than conventional mills.

BIG NUMBER THAT TELLS AN EVEN BIGGER STORY

ACCURATE TO 50 MILLIONTHS of an inch, this Universal Measuring Machine checks the gages and machine parts used to make Timken bearings. The Timken Company has one of the world's best-equipped gage inspection rooms. It contains precision equipment, some of which is so unusual we had to develop it ourselves. It's another reason Timken bearings are the number-one value for your car's moving parts—the vital zone.



WE NEED THE WORLD'S BEST bearing steel so we make our own. This way we can control quality every step of the way, from melt shop to finished bearing. Shown above is a special piercing mill that makes seamless tubing for Timken® bearing cones and cups. This mill uses the special Timken-Company-developed "elongator" process that provides closer size tolerances than conventional mills.



WE WORK FOR YOU, making special tests and studies. This test simulates actual driving loads on truck front axles. It "runs" axles thousands of miles, helps show truck manufacturers how to get longer bearing life. Service like this is another reason for always specifying "Timken" with the bearing number. And for full value always use a Timken bearing cup with a Timken bearing cone. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St Thomas, Ontario. Cable: "TIMROSCO".

TIMKEN is number 1 for VALUE where value counts most . . . in the vital zone

TIMKEN-MOORE REG. U.S. PAT. OFF

NOT JUST A BALL ◯ NOT JUST A ROLLER ⬭ THE TIMKEN TAPERED ROLLER ⬭ BEARING TAKES RADIAL AND THRUST → ← LOADS OR ANY COMBINATION